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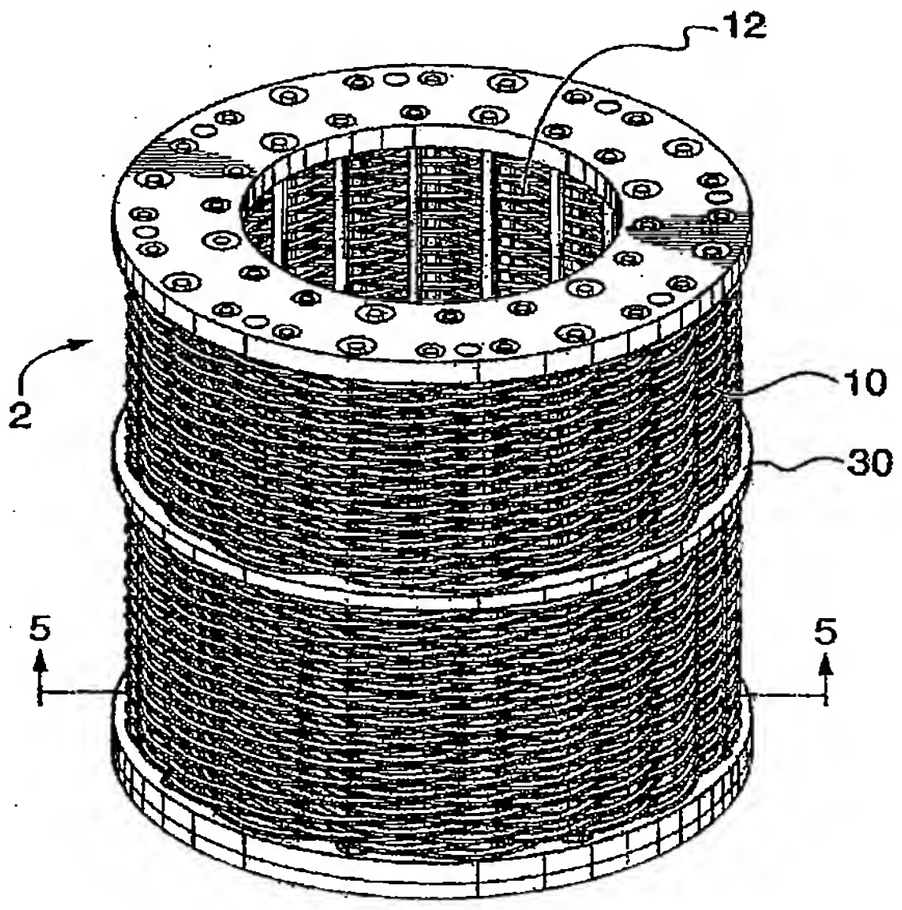
(54) FILTRE TRESSE POUR UN CABLE DE TRACTION
(54) BRAIDED STRAINER FOR A DRAW LINE

(57)

A braided strainer for a draw line, and method of forming same. The strainer comprises a frame in the form of a pair of spaced planar plates, one being a solid end plate and the other having a control aperture. A plurality of spaced, parallel rods of similar length are positioned near the peripheries of the plates and secured and extending between the plates. A plurality of cylindrical walls of braided strands of strainer medium, are provided, the braided cylindrical walls having similarly spaced rod-receiving holes extending longitudinally in spaced fashion through the strands of strainer medium. These walls are contiguously stacked on the plates to extend between them. The plate having the central aperture permits flow of fluid drawn through the cylindrical walls during operation of the strainer. That plate has associated with it a connector to releasably secure the strainer to a mating connector on a free end of the draw line.



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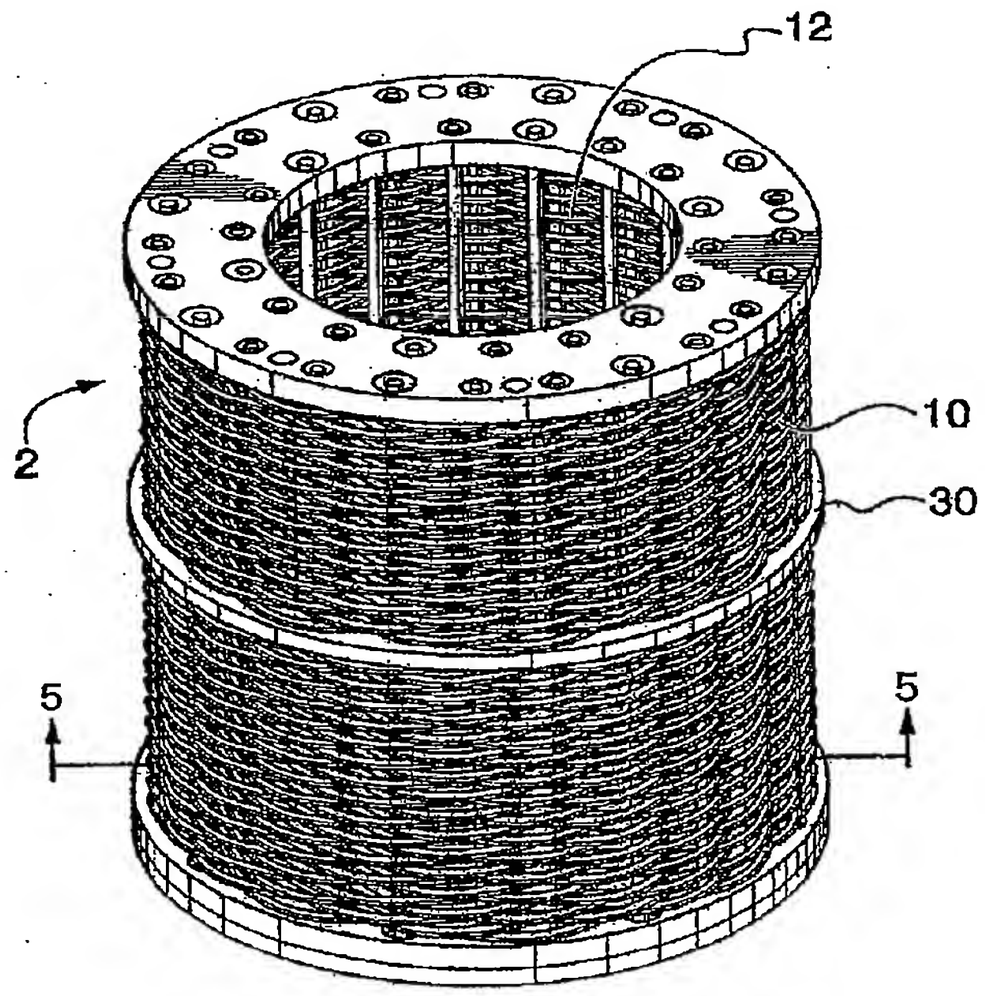
(54) Title: BRAIDED STRAINER FOR A DRAW LINE



(57) Abrégé/Abstract:
A braided strainer for a draw line, and method of forming same. The strainer comprises a frame in the form of a pair of spaced planar plates, one being a solid end plate and the other having a control aperture. A plurality of spaced, parallel rods of similar length are positioned near the peripheries of the plates and secured and extending between the plates. A plurality of cylindrical walls of braided strands of strainer medium, are provided, the braided cylindrical walls having similarly spaced rod-receiving holes extending longitudinally in spaced fashion through the strands of strainer medium. These walls are contiguously stacked on the plates to extend between them. The plate having the central aperture permits flow of fluid drawn through the cylindrical walls during operation of the strainer. That plate has associated with it a connector to releasably secure the strainer to a mating connector on a free end of the draw line.

ABSTRACT OF THE DISCLOSURE

A braided strainer for a draw line, and method of forming same. The strainer comprises a frame in the form of a pair of spaced planar plates, one being a solid end plate and the other having a control aperture. A plurality of spaced, parallel rods of similar length are positioned near the peripheries of the plates and secured and extending between the plates. A plurality of cylindrical walls of braided strands of strainer medium, are provided, the braided cylindrical walls having similarly spaced rod-receiving holes extending longitudinally in spaced fashion through the strands of strainer medium. These walls are contiguously stacked on the plates to extend between them. The plate having the central aperture permits flow of fluid drawn through the cylindrical walls during operation of the strainer. That plate has associated with it a connector to releasably secure the strainer to a mating connector on a free end of the draw line.

TITLE OF THE INVENTION

BRAIDED STRAINER FOR A DRAW LINE

FIELD OF THE INVENTION

The present invention relates to a strainer for filtering coarse debris from a fluid or from solids, the strainer usable for example with fire truck hoses for drawing water from rivers, lakes or ponds.

BACKGROUND OF THE INVENTION

Generally, when such strainers are used in a fluid, the strainer assembly is submerged into the fluid and always must have a means of connecting to a hose, piping or to a fixture, hereinafter called a "draw line". Strainers generally use a strainer medium formed from perforated sheets of specified orifice or openings or, as in the case of Avery et al. U.K. Patent No. 2,318,305, from a woven strands of material. The construction proposed by Avery et al. presents difficulties in that a woven material may be prone to tearing or dislocation of certain of the strands of strainer medium, making the strainer less effective. As well, constructing such a strainer, by weaving the fabric, is a laborious and time consuming process, resulting in a relatively expensive product.

Problems encountered with perforated sheets of specified orifice or openings include the creation of vortexes which, reduce the efficiency of the draw line. A vortex is defined as a whirling mass of fluid forming a vacuum at its center, into which anything caught in the motion is drawn. Natural vortexes caused by draw fluids are to be avoided where possible, since larger vortexes tend to draw more debris and clog up the strainers more quickly.

It is an object of the present invention to provide an improved draw line strainer which is economical to manufacture and effective in operation.

SUMMARY OF THE INVENTION

In accordance with the present invention there is provided a braided strainer for a draw line, and a method for making same. The method of forming the braided strainer comprises the steps of stacking a plurality of cylindrical strainer walls formed of braided strands of strainer medium and having similarly spaced rod-receiving holes extending linearly longitudinally in spaced fashion through the walls, onto parallel, upstanding rods of similar length, the rods secured to a base plate, by passing the rods through corresponding rod-receiving holes in the walls so that the braided walls are stacked on the plate up to the free ends of the rods in contiguous fashion, and securing a retainer plate on the free ends of the rods to secure the braided walls in stacked position on the rods. In one embodiment of the invention, the strainer walls are cylindrical.

In an alternative embodiment of the present invention, the method comprises forming a plate having a plurality of parallel, upstanding rods of similar length secured in spaced regular, upstanding, fashion about the plate, embedding a length of braided strands of strainer material, in spiral fashion to form a uniform strainer wall over the length of the rods and securing a retainer plate on free ends of the rods adjacent a portion of the length of strainer medium.

As well, the invention relates to a braided strainer for a draw line, the strainer comprising a frame in the form of a pair of spaced planar plates, one being

a solid end plate and the other having a central aperture, and a plurality of spaced, parallel rods of similar length positioned near the peripheries of the plates and secured and extending between the plates. A plurality of cylindrical walls of braided strands of strainer medium, the braided cylindrical walls having similarly spaced rod-receiving holes extend longitudinally in spaced fashion through the strands of strainer medium, are contiguously stacked on the plates to extend between them. The plate having the central aperture permits flow of fluid drawn through the cylindrical walls during operation of the strainer into the draw line. That plate has associated with it a connector to releasably secure the strainer to a mating connector on a free end of the draw line.

In an alternative embodiment of the strainer according to the present invention, the braided strainer is double-walled, having a first, outer strainer and a second, smaller strainer within, both strainers being secured to the plate having the central aperture, so that the wall of the second strainer is inwardly spaced from the wall of the first strainer.

The strainer according to the present invention is relatively simple and economical to construct. Because of the braided wall construction of the strainer.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other advantages of the invention will become apparent upon reading the following detailed description and upon referring to the drawings in which:-

FIGURE 1 is a schematic view of a strainer according to the present invention attached to the end of a draw line.

FIGURE 2 is a perspective view of a strainer according to the present invention.

FIGURE 3 is a perspective view of the strainer of Figure 2 with the braided strainer walls removed.

FIGURE 4 is an exploded perspective view of the strainer of figure 2.

FIGURE 5 is a section view along line 5-5 of figure 2.

FIGURE 6 is a perspective view of a braided cylindrical wall for use in a strainer according to the present invention.

FIGURE 7 is a partial perspective view of a length of braided strands of strainer medium used to produce an alternative embodiment of strainer according to the present invention.

FIGURE 8 is a side view of a rod forming a part of the framework of the strainer according to the invention.

FIGURE 9 is a cross-section view along line (9-9) of figure 7 of a strand of strainer medium in accordance with the present invention.

FIGURE 10 is a cross-section view of the rod of figure 8 along line 10-10 of figure 8.

While the invention will be described in conjunction with illustrated embodiments, it will be understood that it is not intended to limit the invention to such embodiments. On the contrary, it is intended to cover all alternatives, modifications and equivalents as may be included within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following description, similar features in the drawings have been given similar reference numerals.

Turning to figure 1 there is illustrated a strainer (2) in accordance with the present invention, secured by appropriate connection means (4) such as a bolted flange (illustrated), or (not illustrated) a hose shank connector, cam lock connection, storks connection, threaded swivel connection or the like, to a mating connector on draw line (6) to join strainer (2) to draw line (6). The strainer as illustrated is immersed in a pond and is intended to strain coarse debris which otherwise would become entrained in the draw line water as it is pumped through action of pump (8). The connector (4) is intended to provide for an unlimited number of quick detachable or standard threaded connectors. Some connections may allow the strainer (2) to rotate or pivot without disturbing the draw line.

An example embodiment of strainer (2) is illustrated in figures 2 to 5. In this embodiment, a doubled wall strainer (2) is provided, having an outer wall (10) of strainer media which will be described in more detail hereinafter, and an inner wall (12) of filter media (which may be of different composition and/or of different dimension than that of the outer wall),inwardly spaced from outer wall (10) (as will be understood for example from figure 3). This two wall or two stage strainer permits smaller diameter debris to flow through the outer wall and become trapped in the inner wall, while the outer wall traps larger debris.

More particularly, as can be seen in figure 3, strainer 2 is made up of a cylindrical base plate (14) and an upper, annular plate (16), in the center of which is

an aperture (18) through which strained fluid will flow to the draw line (6) during operation of the device. This upper plate (16) is common to both outer wall (10) and inner wall (12). A plurality of uniformly spaced, upstanding, parallel rods (20) are provided, positioned slightly inwardly from the peripheral edges of base plate (14) and upper plate (16) as illustrated. Every third rod (20) is a metal (e.g. stainless steel), threaded rod (22), and the two rods (24) in between are of appropriate metal or of plastic material such as polypropylene. These rods (24) have longitudinally extending ribs (26) on their outer surfaces to act as "deflector ribs" (figures 8 and 9). These ribs may be outwardly extending , as shown, or formed as longitudinally extending grooves in the outer surfaces of the rods. These ribs generate certain vibrations and turbulence during fluid flow. The rods (22) and (24) are secured to base plate (14) for outer wall (10), and provide an anchored, vertical framework for the strainer

A "play" may be provided in the rods (24) however to permit the framework of strainer (2) to move under stress conditions or abuse. This is accomplished for example by tapering rods near their ends, and mushrooming their ends as can be seen in figure 8 . Similar threaded rods (22) and ribbed rods (24) are provided for inner wall (12), although these rods are anchored to inner wall base plate (28).

Intermediate plates (30) are provided and installed at specific locations along the vertical height of rods (22) and (24) as illustrated. These intermediate plates also extend outwardly beyond their corresponding rods (as do base plates (14) and (28) and upper plate (16)) and prevent the framework, provided by rods (22) and (24), from collapsing under heavy vacuum conditions during use of strainer (2).

Supported by the framework including rods (22) and (24) and upper plate (16) and base plates (14) and (28), in accordance with the present invention, are a plurality of stacked braided rings (31) or loops of strainer material. That strainer material is in the form of continuous strands (32) of metal or non-metal (e.g. plastic) compound as can be seen in figure 5 or 6. Preferably a loop of three braided strands is provided as a unit, a plurality of such units being stacked on rods (22) and (24), as illustrated in figure 4 to form outer wall (10). These rings (31) may be formed by casting or molding through an injection process, or bonded or chemically bonded. The strainer medium used may be selected according to desired chemical and physical properties such as chemical resistance, flexibility, tensile strength, elongation, expansion or contraction during temperature changes, etc. That medium may be of any appropriate metal, metal alloy, non metal or plastic material. The rings are constructed with multiple chambers equally spaced on a specific circumference of the ring, and are provided with appropriately positioned rod - receiving holes (34) (figure 5) to enable individual rings to be stacked, in contiguous fashion, on rods (22) and (24), thereby forming outer wall (10). A plurality of smaller diameter rings of similar construction are stacked contiguously on the upstanding rods (22) and (24) of inner wall base plate (28), to form inner wall (12).

To control the size of objects that are allowed to flow through the strainer media forming outer wall (10) and inner wall (12), the diameter of the strands (32) is increased or decreased. For example if it is desired to strain objects larger than 5 millimeters, a set of rings (31) would be formed with five millimeter diameter strands. There is a wide range of available diameters for the strands because of the molding

or casting process, since any reasonable size of medium strand may be cast or molded for any practical size of strainer and desired flow rate. In the illustrated embodiment, the two stage strainer (2) permits smaller diameter debris to flow through outer wall (10), formed with rings having larger diameter strands (32), and become trapped on the outside of inner wall (12) having smaller diameter strands (32). This construction with two different sized strainer media provides a significant enlarging of the surface area available to trap debris, thus prolonging the total obstruction of the media significantly when compared to a conventional strainer.

As can be seen in the cross-sectional view of a strand (32) illustrated in figure 9, strands (32) are preferably provided with a plurality of deflector ribs (36). These deflector ribs generate certain vibrations and turbulence to the fluid during flow, which in turn disturb the natural vortex caused by the drawing of fluids into the draw line through strainer (2). The strand deflector ribs (36) also become seated in the grooves of the threads of rods (22), thus resisting becoming longitudinally dislocated along the length of rods (22) and (24).

The braided strand construction of rings (31) forming the walls of strainer (2) during operation of the strainer causes the generation of numerous short and narrow vortexes instead of fewer and large vortexes. The larger vortexes will have a greater vacuum and draw more debris into the strainer, thus clogging the strainer at an earlier stage. Furthermore, because of the number of chambers in rings (31) and their location, the length or extension of the vortexes beyond the outer wall (10) is reduced. The vortexes generated by inner wall (12) are also disrupted by strands (32) of the rings (31) forming outer wall (10). This further reduces the amount of debris

that can be drawn towards the outer surfaces of outer wall (10) and inner wall (12). The illustrated construction of strainer (2), with inner and outer walls, is ideal where the fluid bed (e.g. bottom of a river, container or pond) is easily disturbed by large vortexes caused by fluid flow.

It will be understood from the preceding description of strainer (2) that its construction is very straight forward. With annular upper plate (16) and intermediate plates (30) removed, and rods (22) and (24) secured to, respectively, base plates (14) and (28), loops (31) of appropriate diameter and having strands (32) of appropriate cross-sectional diameter and appropriately positioned rod receiving holes (34), are stacked contiguously on corresponding rods (22) and (24), with an intermediate plate (30), again having appropriately positioned rod - receiving apertures, being seated on a plurality of stacked loops, at the desired location. Further rings (31) are then stacked on intermediate plate (30), and, when the stacked loops reach the upper ends of rods (22) and (24), to complete outer wall (10) and inner wall (12), the common annular upper plate (16) is then secured to both sets of rods to form the braided strainer. An appropriate connector means 4 is provide for upper plate (16).

The advantages of this method of construction are many. The rings (31) have an unlimited stacking height depending upon the desired flow rate and the length of rods (22) and (24). A greater number of rings (31) on strainer (2), will produce a higher flow rate. The rings have an exact dimension that produces a constant, precalculated flow rate per ring. The ring strands (32) are designed and cast or molded with specific deflector ribs (36) on the circumferences of the strands. The number of deflectors (36) on each strand may be varied to suit the application or fluid

type to generate desired vibrations and turbulence and assist in the breaking down of the flow of the vortexes. A further advantage of the strainer construction 2 according to the present invention is that, if damage occurs to strands 32, the appropriate ring 31 which has been damaged can be easily removed for replacement.

While rings (31) having three braided strands (32) have been illustrated, it will be understood that rings (31) may be manufactured with more than three strands.

While strainer (2) has been illustrated as having inner and outer walls, it will be readily understood that a strainer according to the present invention may be constructed having a single wall (e.g. with just outer wall (10) and base plate (14) with upper plate (16) and appropriate intermediate plate or plates (30) and rings (31) of braided strands (32)).

The positioning of upstanding rods (20) slightly inwardly of the outer peripheral portions of the base plate (14) and, intermediate and upper plates (30) and (16), provides protection for the strainer medium (strands (32)) of outer wall (10), for instance protecting the medium from direct damage when strainer (2) is dragged across a surface.

In yet another embodiment of the present invention as can be seen in figure 7, instead of rings or loops (31) of strands (32), a single length (38) of braided strands (32) (preferably three such strands) may be manually or mechanically braided, the strands (32) having a specific diameter and, as appropriate, deflector ribs (36) extruded on their exterior surfaces. The strands would again be fitted on and supported by the upstanding rods (20), but would sit there as a continuous expanded

braid to the upper plate height or, if required, to the intermediate plate height and then as a further continuous expanded braid from that intermediate plate to the upper plate.

Thus, it is apparent that there has been provided in accordance with the invention a braided strainer and method of making same that fully satisfies the objects, aims and advantages set forth above. While the invention has been described in conjunction with illustrated embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art in light of the foregoing description. Accordingly, it is intended to embrace all such alternatives, modifications and variations as fall within the spirit and broad scope of the invention.

WHAT IS CLAIMED IS:

1. A method of forming a braided strainer for a draw line, the method comprising the steps of stacking a plurality of braided strainer walls formed of braided strands of strainer medium and having similarly spaced rod-receiving holes extending linearly longitudinally in spaced fashion through the walls, onto parallel, upstanding rods of similar length, the rods secured to a base plate, by passing the rods through corresponding rod-receiving holes in the walls so that the braided walls are stacked on the plate up to free ends of the rods in contiguous fashion, and securing a retainer plate on the free ends of the rods to secure the braided walls in stacked position on the rods.

2. A method according to claim 1 wherein the strainer walls are of cylindrical configuration.

3. A method according to claim 2 wherein each strainer wall is formed of a plurality of braided loops of strands of strainer medium.

4. A method according to claim 1 wherein each strainer wall comprises three braided strands of strainer medium.

5. A method according to claim 1 wherein fluid deflector ribs are formed on the strands.

6. A method according to claim 1 wherein each of the braided cylindrical walls is formed by a method selected from the group consisting of casting, injection molding, bonding and chemical bonding.

7. A method of forming a braided strainer or a draw line, the method comprising forming a circular plate having a plurality of parallel, upstanding rods of similar length secured in regular, upstanding, circular fashion about the plate, and embedding a length of braided strands of strainer medium, in spiral contiguous fashion on the rods in contiguous fashion to form a uniform cylindrical strainer wall over the length of the rods and securing a retainer plate on free ends of the rods adjacent a portion of the length of strainer medium.

8. A method according to claim 7 wherein the length of filter medium comprises three braided strands of strainer medium.

9. A method according to claim 8 wherein fluid deflector ribs are formed on the strands.

10. A braided strainer for a draw line, the strainer comprising a frame in the form of a pair of spaced planar plates, one a solid end plate and the other having a central aperture, and a plurality of spaced, parallel rods of similar length positioned near the peripheries of the plates and secured and extending between the plates, and a plurality of walls of braided strands of strainer medium, the braided walls having

similarly spaced rod-receiving holes extending longitudinally in spaced fashion through the strands of filter medium, contiguously stacked on the plates to extend between them, the plate having the central aperture permitting flow of fluid drawn through the walls during operation of the strainer into the draw line, that plate having associated with it a connector to releasably secure the strainer to a mating connector on a free end of the draw line.

11. A strainer according to claim 10 wherein the strainer wall are of cylindrical configuration.

12. A strainer according to claim 11 wherein each of the braided cylindrical walls is formed of three strands of strainer medium.

13. A strainer according to claim 12 wherein the fluid deflector ribs are provided on the strands.

14. A strainer according to claim 10 wherein the plates are of circular shape.

15. A strainer according to claim 10 wherein one or more of the rods are provided with deflector ribs on their outer surfaces to generate vibrations and turbulence in fluid flow during use of the strainer.

16. A strainer according to claim 13 wherein one or more of the rods are provided with deflector ribs on their outer surfaces to generate vibrations and turbulence in fluid flow during use of the strainer.

17. A strainer according to claim 13 wherein one or more of the rods are threaded along their lengths whereby deflector ribs on the strands are partially engaged by the threads to thereby minimize vertical displacement of the strands with respect to the rods.

18. A double walled braided strainer for a draw line comprising a first strainer according to claim 10 and a second, smaller strainer according to claim 10 secured to the plate having the central aperture, so that the wall of the second strainer is inwardly spaced from the wall of the first strainer.

19. A double walled braided strainer according to claim 18 wherein the second, inner strainer has an end plate spaced from the end plate of the first strainer.

20. A strainer according to claim 18 wherein the outer peripheries of the spaced planar plates of the first strainer extend beyond the walls of braided strainer medium whereby the strainer medium of the first strainer is protected from direct damage when the strainer is dragged across a surface.

21. A strainer according to claim 18 wherein the fluid deflector ribs are provided on the strands.

22. A strainer according to claim 18 wherein one or more of the rods are provided with deflector ribs on their outer surfaces to generate vibrations and turbulence in fluid flow during use of the strainer.

23. A strainer according to claim 21 wherein one or more of the rods are provided with deflector ribs on their outer surfaces to generate vibrations and turbulence in fluid flow during use of the strainer.

24. A strainer according to claim 21 wherein one or more of the rods are threaded along their lengths whereby deflector ribs on the strands are partially engaged by the threads to thereby minimize vertical displacement of the strands with respect to the rods.

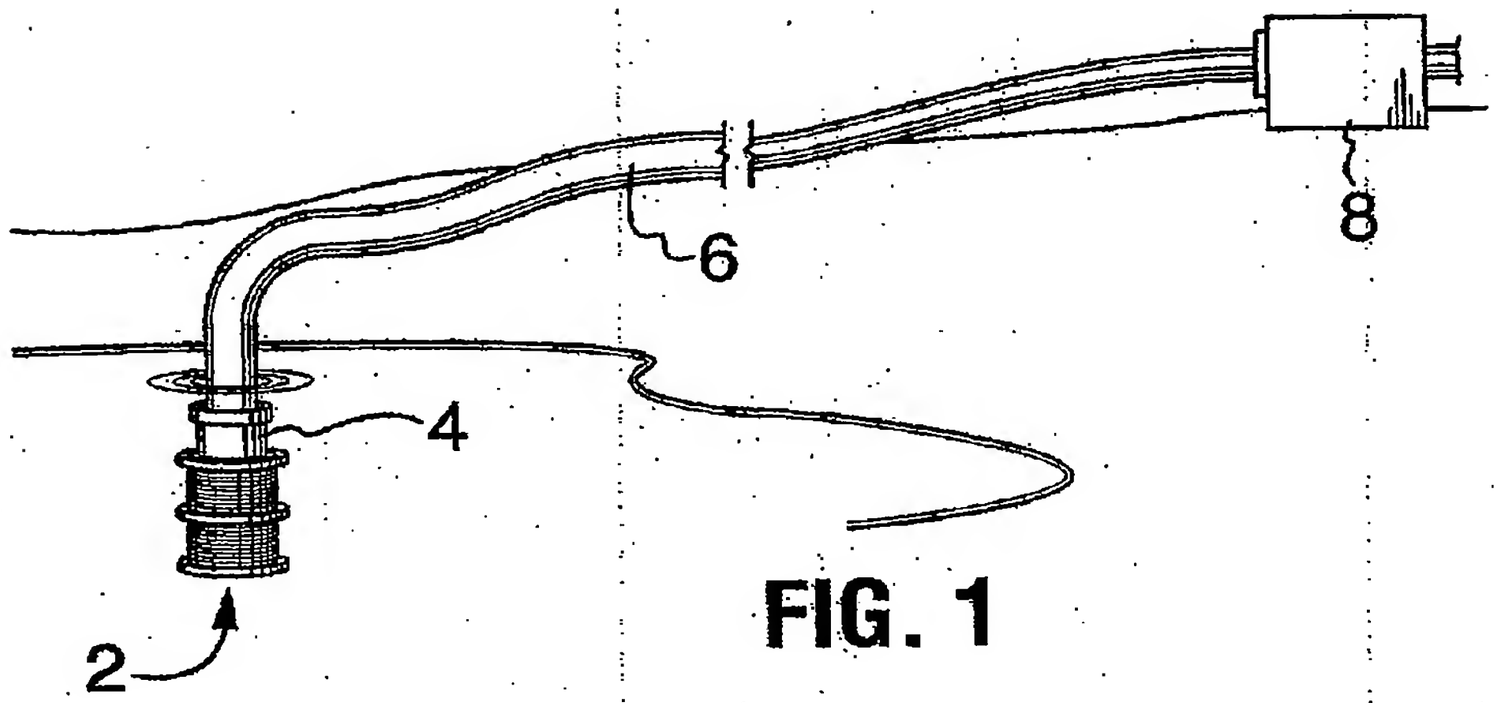


FIG. 1

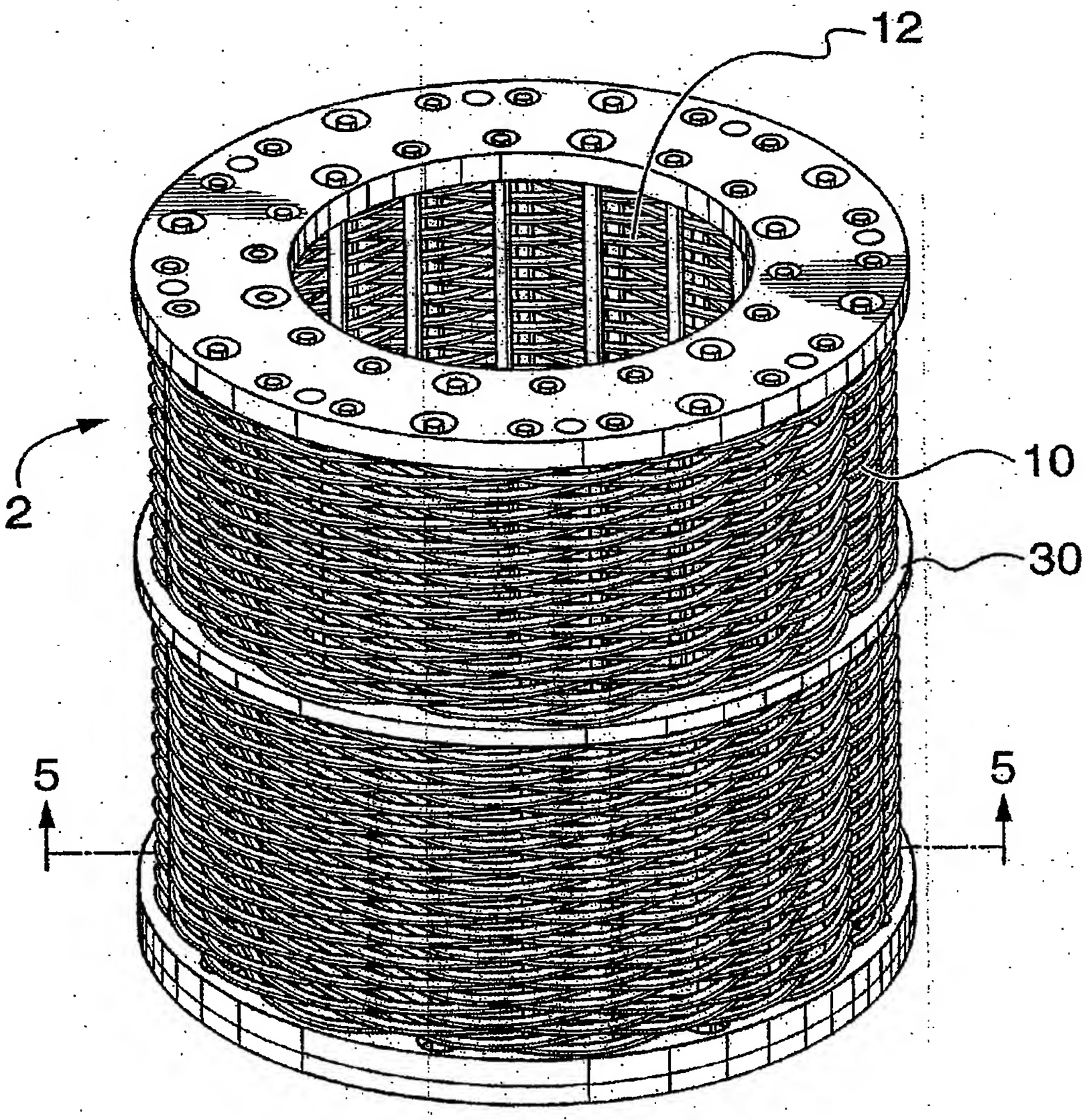


FIG. 2

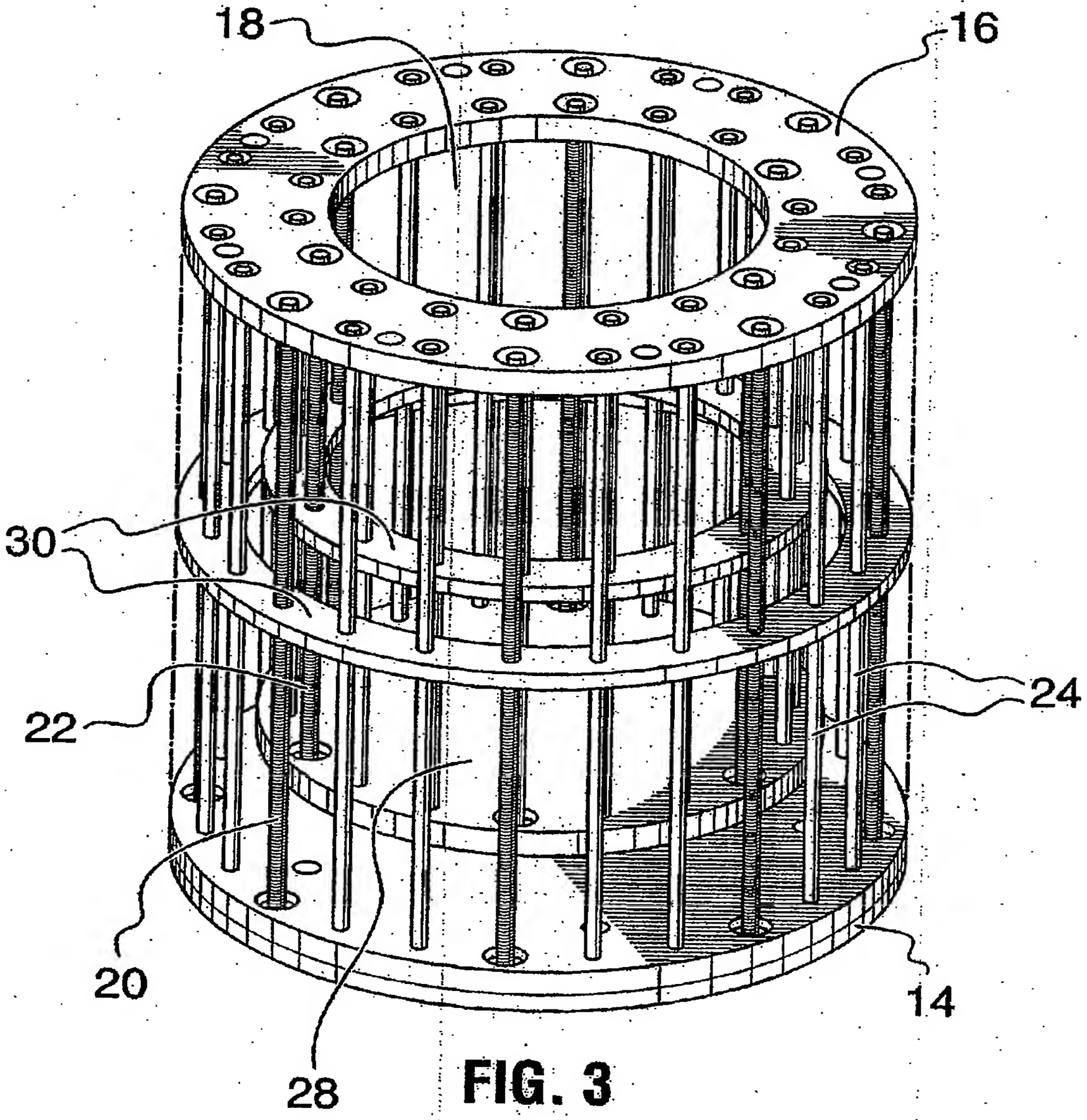


FIG. 3

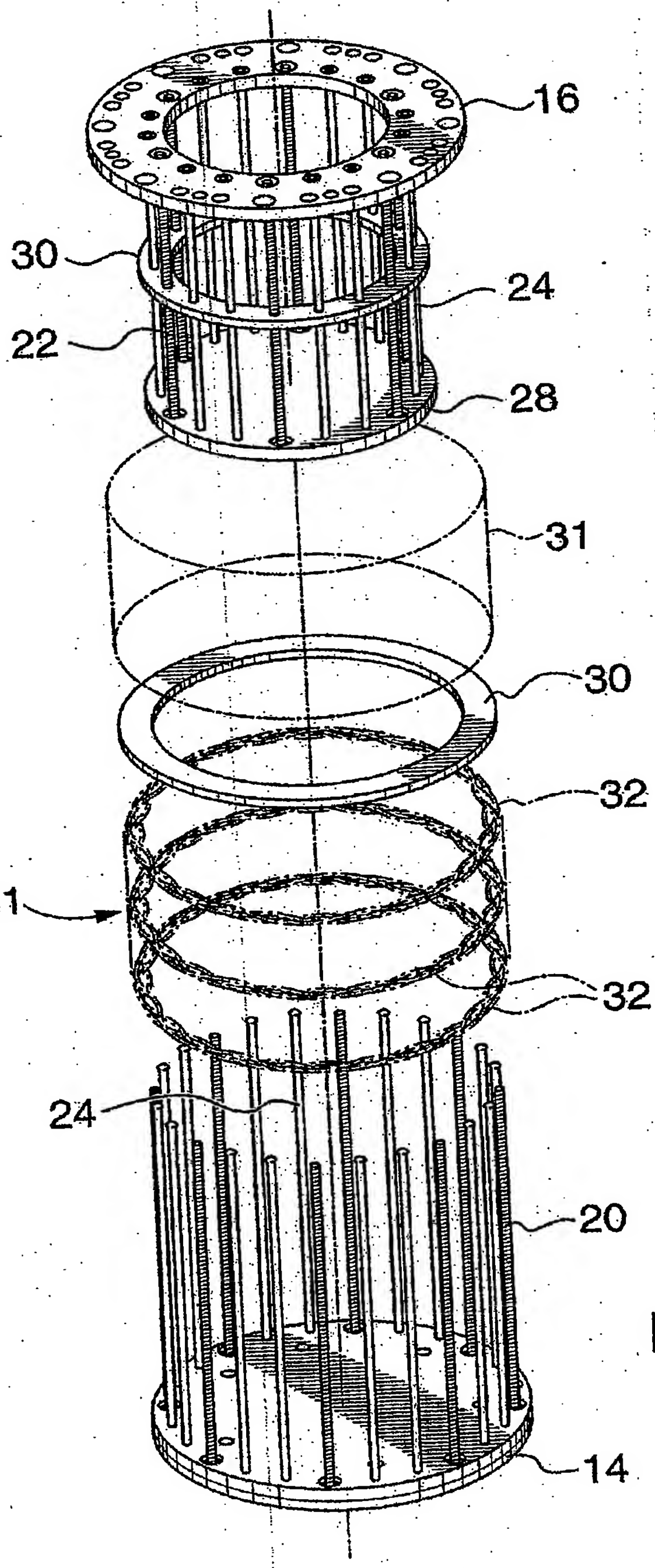


FIG. 4

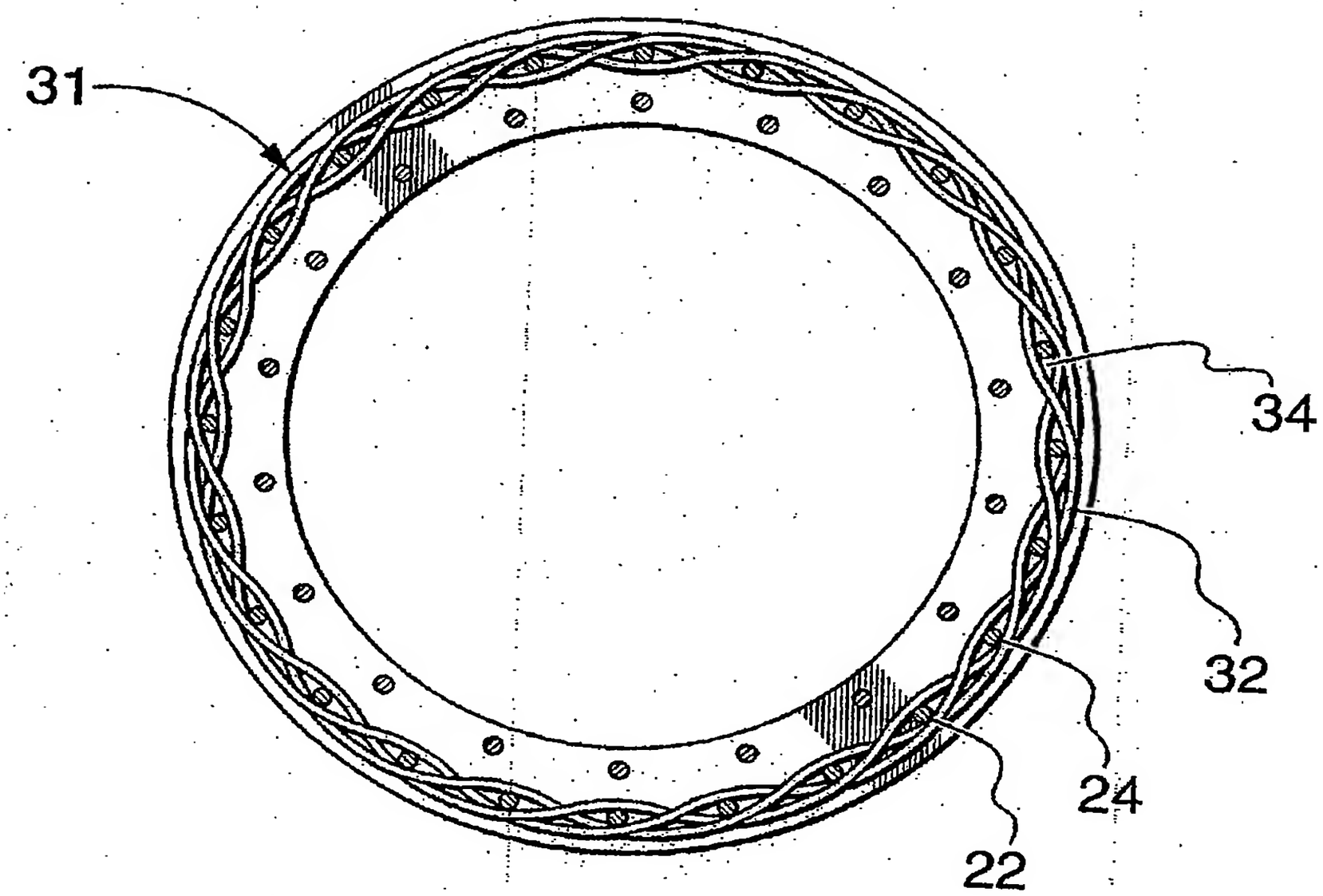


FIG. 5

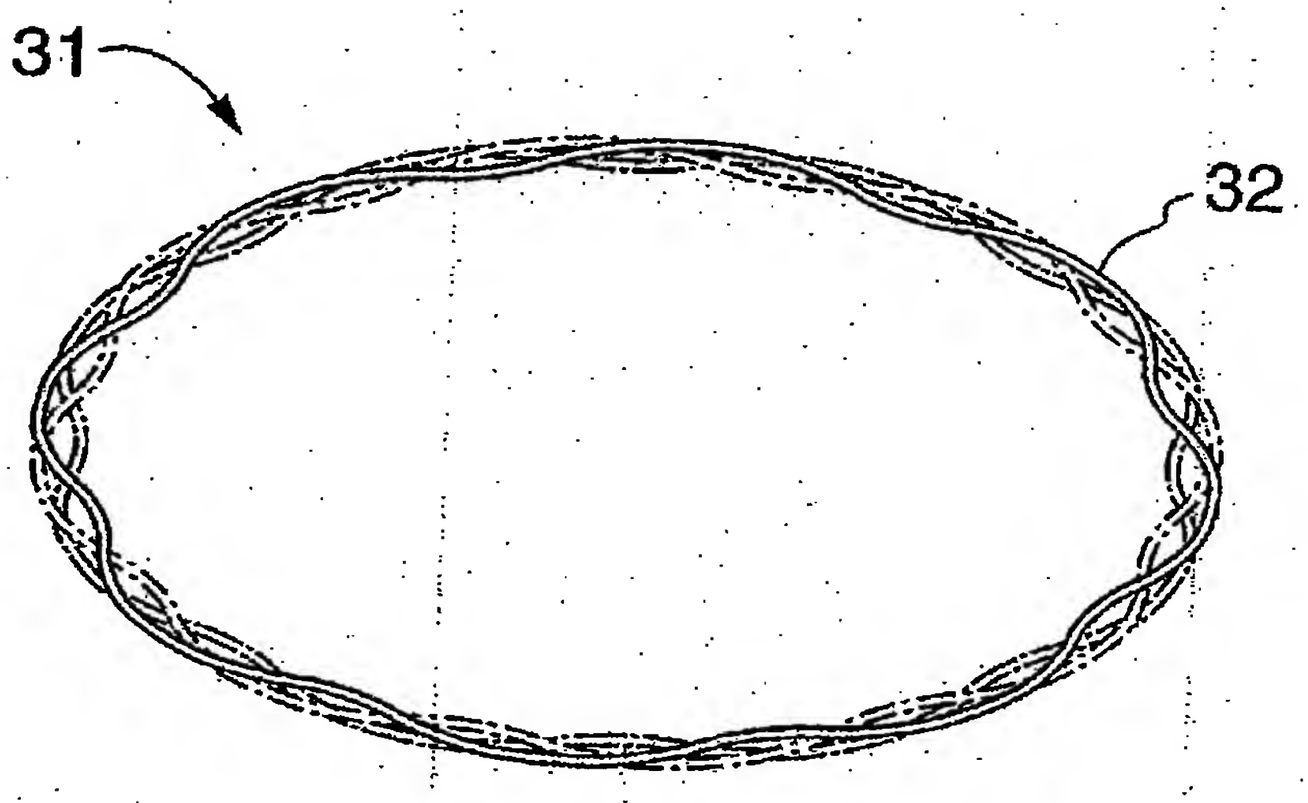


FIG. 6

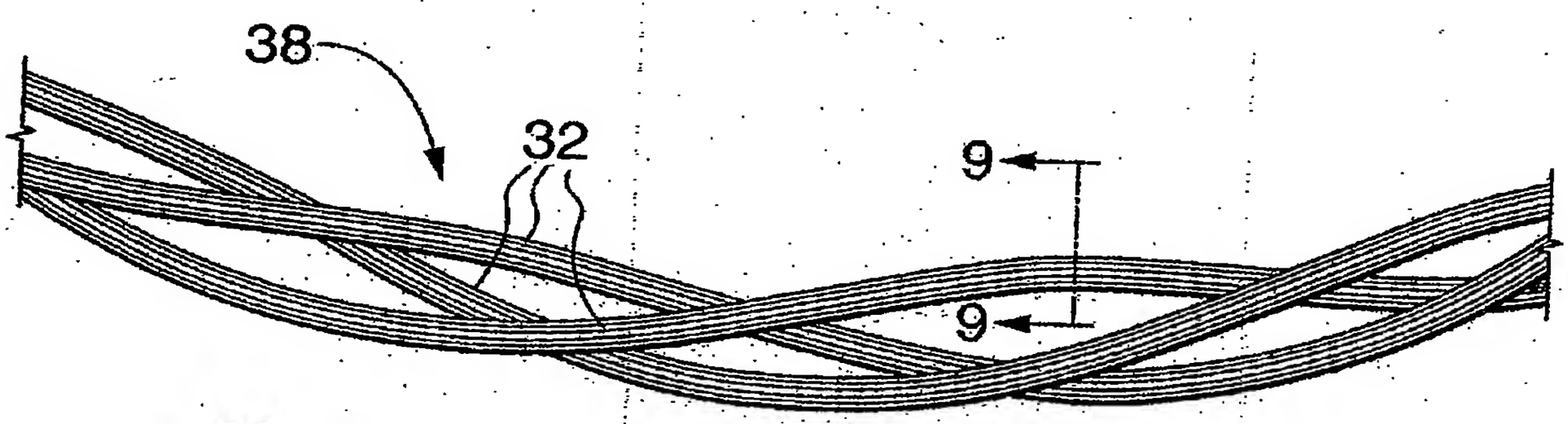


FIG. 7

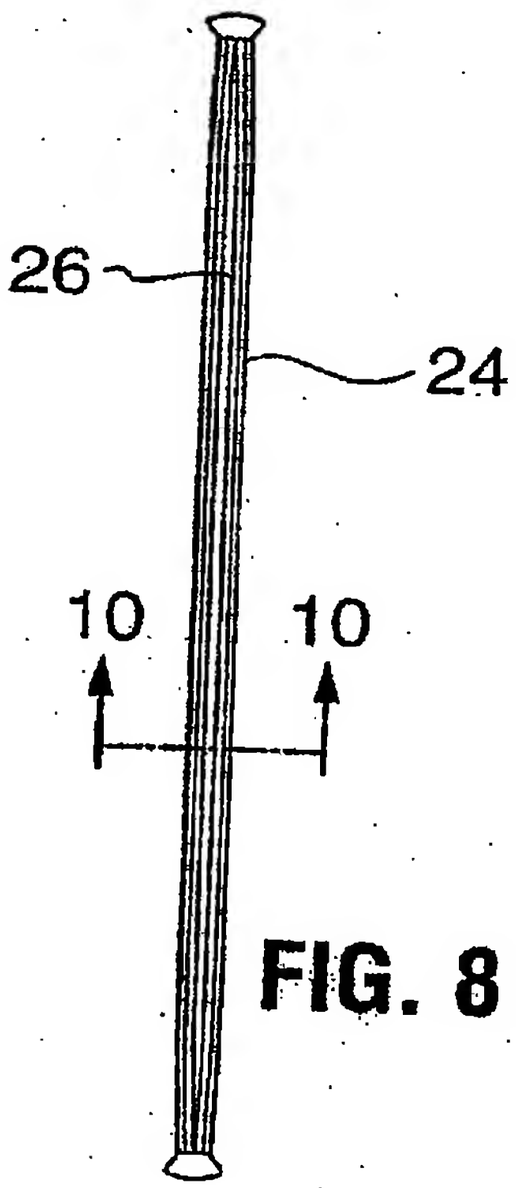


FIG. 8

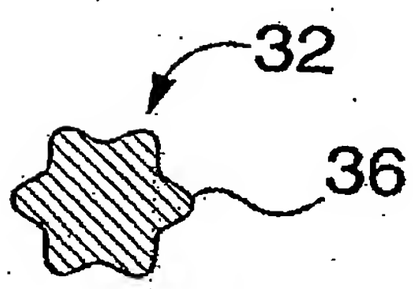


FIG. 9

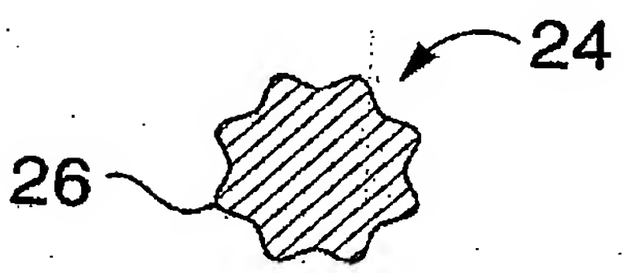


FIG. 10

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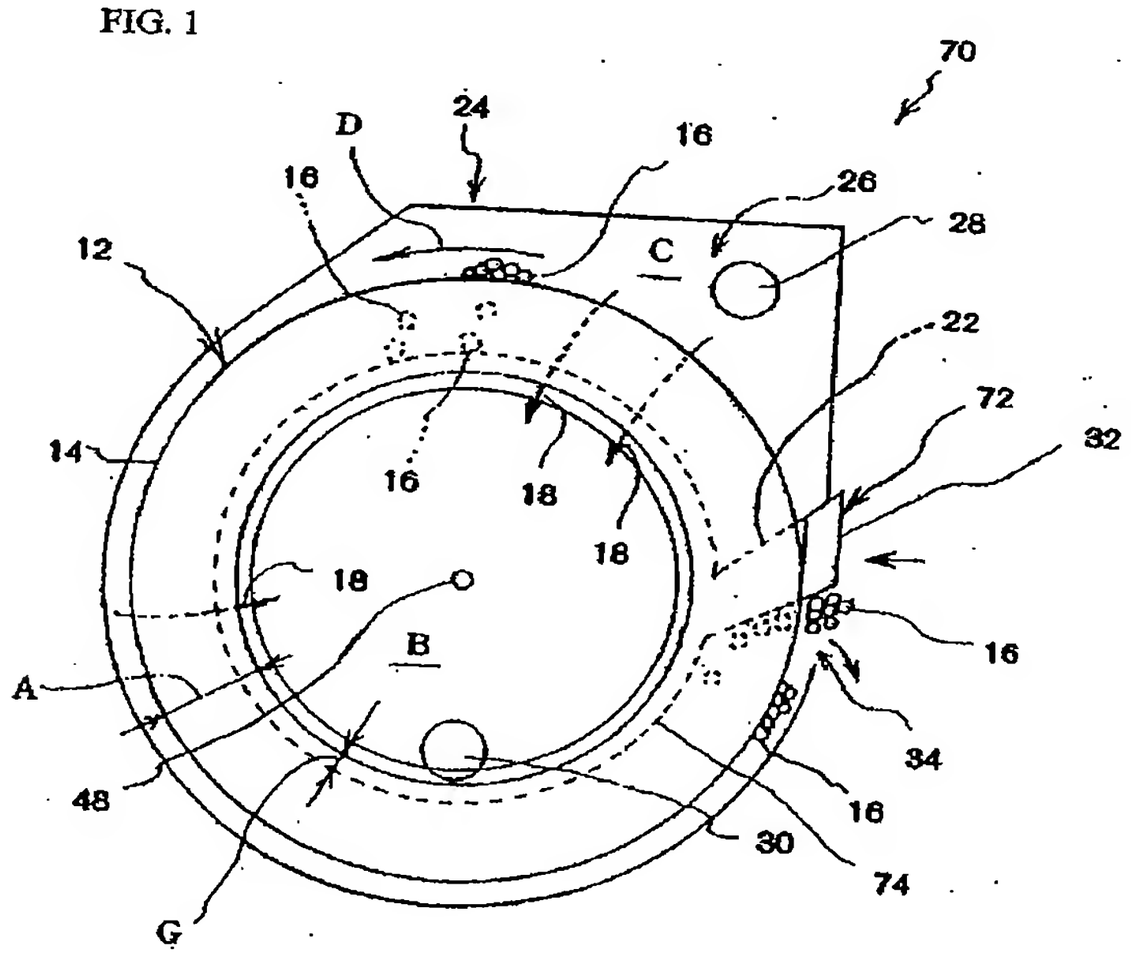
(54) Solid-liquid separating apparatus

(57) A solid-liquid separating apparatus comprising a cylindrical strainer formed by circular ring members with gaps in between, a casing having the strainer therein, and scrapers disposed in the respective gaps between the circular ring members for removing solid matter adhering to the end (flat) surfaces of the circular ring members. Each of the scrapers comprises a flat auxiliary circular ring member and a flat protruding element. The external diameter of the auxiliary circular ring member is smaller than the external diameter of the circular ring members and is larger than the internal diameter of the circular ring members, and the protruding element extends from the outer circumferential surface of the auxiliary circular ring member. The auxiliary circular ring members are disposed coaxially with the circular ring members, and the tip ends of protruding elements reach the outer circumferences of the circular ring members.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a solid-liquid separating apparatus for separating solid matter, raw contaminants, etc. from liquid of a solid-liquid mix.

2. Prior Art

[0002] Solid-liquid separating apparatus are used in, for example, raw contaminant dehydration treatment devices, etc. installed in kitchen sinks. Such solid-liquid separating apparatus separates the solid matter and liquid from water-containing raw contaminants produced as a mixture of solid matter and liquid by mixing raw contaminants discharged from the kitchen with water and pulverizing this mixture.

[0003] One of such solid-liquid separating apparatuses is described in Japanese Patent Application No. H11-133089 (Laid-Open (Kokai) No. 2000-317693) filed by the applicant of the present application.

[0004] This prior art solid-liquid separating apparatus will be described with reference to Figures 6 and 7.

[0005] The solid-liquid separating apparatus 10 is comprised substantially of a strainer 12 and a casing 24.

[0006] The strainer 12 is in a cylindrical shape by way of arranging a plurality of flat-plate-form circular ring members 14 adjacent each other with specified gaps in between. The casing 24 has an accommodating section 26 that accommodates the strainer 12.

[0007] The accommodating section 26 is divided by the strainer 12 into two regions: an internal region B that is inside the strainer 12 and an external region C that is outside the strainer 12. An intake port 28 that introduces a mixture of solid matter and a liquid is formed in the external region C, and an outlet port 30 that discharges to the outside the liquid that passes between the circular ring members 14 and advances into the internal region B is formed in the internal region B.

[0008] The solid-liquid separating apparatus 10 further includes a scraper 20. The scraper 20 is comprised of a plurality of flat-plate-form (fin-form) protruding elements 22 so that the tip ends thereof enter the respective gaps between the circular ring members 14. The scraper 20 is moved relative to the strainer 12 and the protruding elements 22 thereof scrape away solid matter adhering to the end surfaces (or the flat, side surfaces) of the circular ring members 14 that form the strainer 12. The flat-plate-form protruding elements 22 enter from the outer circumferential sides of the circular ring members 14 into the gaps. The tip ends of the protruding elements 22 reach the inner circumferential surfaces of the circular ring members 14 and advance into the internal region B of the strainer 12.

[0009] Both end surfaces (flat surfaces) of the respective flat-plate-form protruding elements 22 that enter the respective gaps between the circular ring members 14, i.e., the spaces between the end surfaces (flat surfaces) of the circular ring members 14, make rubbing contact with the end surfaces (flat surfaces) of the circular ring members 14 that are positioned on both sides of each flat-plate-form protruding element 22.

[0010] The plurality of flat-plate-form protruding elements 22 are provided on, for instance, a supporting member 32 (see Figure 7). The protruding elements 22 protrude from the supporting member 32 toward the strainer 12. The supporting member 12 is installed parallel to the axis of the strainer 12 and forms a part of the scraper 20 together with the flat-plate-form protruding elements 22. The flat-plate-form protruding elements 22 are arranged so as to have gaps in between that are substantially equal in size to the thickness of the circular ring members 14 and also have a fixed spacing between adjacent flat-plate-form protruding elements 22. As one example, the flat-plate-form protruding elements 22 are in a wedge shape (see Figure 6). The end surfaces of the protruding elements 22 on the upstream side with respect to the direction of rotation D of the strainer 12 are formed as inclined surfaces with respect to the radial direction of the circular ring members 14. As a result, the solid matter that has been scraped away from the end surfaces of the circular ring members 14 is gradually moved toward the outer circumferences of the circular ring members 14 as the strainer 12 rotates.

[0011] Furthermore, the edge of the end surface of the supporting member 32 on the upstream side with respect to the direction of rotation D (see Figure 6) of the strainer 12 is in contact with the outer circumferential surfaces of the circular ring members 14 so as to function as a scraper that scrapes away the solid matter 16 deposited on the outer circumferential surfaces of the circular ring members 14. Accordingly, the end surface of the supporting member 32 on the upstream side with respect to the direction of rotation D of the strainer 12 is formed as an inclined surface with respect to the radial direction of the circular ring members 14. Thus, the solid matter 16 that has been scraped from the outer circumferential surfaces of the circular ring members 14 is gradually moved away from the circular ring members 14 as the strainer 12 rotates.

[0012] With the structure above, the scraper 20 scrapes away the solid matter 16 adhering to the end surfaces of the circular ring members 14 by the flat-plate-form protruding elements 22, and solid matter 16 adhering to the outer circumferential surfaces of the circular ring members 14 is scraped away by the end surface of the supporting member 32 that is located on the upstream side with respect to the direction of rotation D of the strainer 12. The solid matter 16 that has been scraped away is moved by the flat-plate-form protruding elements 22, which are formed with inclined surfaces that incline with respect to the radial direction of the scraper 20, and by the end surface of the supporting

member 32 that is located on the upstream side with respect to the direction of rotation D of the strainer 12. As a result, the solid matter 16 is extracted through a discharge opening 34 disposed in the casing 24 and on the upstream side of the scraper 20.

[0013] The driving device 36, that is a motor and the like, rotates the strainer 12. The strainer 12 is rotated continuously during the solid-liquid separation process.

[0014] In operation, the strainer 12 acts as a filter. In other words, the liquid 18 passes through the gaps between the stacked circular ring members 14 and advances into the internal region B, and the solid matter 16 that is larger than the gaps is deposited on the outer circumferential surfaces of the circular ring members 14. Some of the solid matter 16 that can advance into the gaps adhere to the end surfaces of the circular ring members 14 and cannot advance into the internal region B. As a result, the solid matter and liquid are separated.

[0015] The liquid 18 that has advanced into the internal region B is discharged to the outside of the casing 24 via the outlet port 30. The solid matter 16 adhering to or deposited on the circular ring members 14 is scraped away by the scraper 20 and discharged to the outside of the casing 24 via the discharge opening 34 that is opened in the casing 24. Since the solid matter 16 deposited or adhering on the outer circumferential surfaces and end surfaces of the circular ring members 14 is scraped away by the scraper 20 each revolution of the strainer 12, no clogging would occur; and solid-liquid separation is continuously performed.

[0016] The space of each one of the gaps between the end surfaces of the respective circular ring members 14 that make up the strainer 12 is determined based upon the size of the solid matter that is to be separated from the liquid. More specifically, if it is desired to separate even solid matter 16 of a small size so that the proportion of solid matter contained in the liquid 18 following the separation is reduced and the quantity of contaminants in the liquid 18 is thus reduced, then the spacing of the gaps between the circular ring members 14 is narrowed. For the opposite case, the spacing of the gaps between the circular ring members 14 is widened to some extent.

[0017] Figures 8 through 10 show the solid-liquid separating apparatus 10 in a concrete manner. The solid-liquid separating apparatus 10 comprises the strainer 12, the casing 24, the scraper 20 and a driving device 36 that rotationally drives the strainer 12.

[0018] The strainer 12 is formed into a cylindrical body by stacking sideways a plurality of circular ring members 14 with gaps in between. The circular ring members 14 consist of two types of ring members: flat-plate-form first circular ring members 14a and flat-plate-form second circular ring members 14b. The second circular ring members 14b have the same external diameter as the first circular ring members 14a, and a plurality of outer projections 38 (in Figure 8, three outer projections 38) are formed at specified angular intervals on the outer circumferential surface of the second circular ring members 14b.

[0019] More specifically, the strainer 12 is formed in a cylindrical body. This cylindrical strainer 12 is obtained by stacking a plurality of the respective circular ring members 14a and 14b side by side with specified gaps between the respective circular ring members 14a and 14b. A specified number of first circular ring members 14a (for instance, a single first circular ring member 14a in Figures 9 and 10) are interposed between two second circular ring members 14b.

[0020] Furthermore, spacers 44 are fitted over first stays 42 that pass through through-holes 40 formed in the respective circular ring members 14a and 14b and integrally connect all of the circular ring members 14a and 14b. Thus, the spacers 44 are used as a means for setting the spacing of the circular ring members 14a and 14b. The thickness of the spacers 44 constitutes the size of the spacing of the gaps between the respective circular ring members 14a and 14b. Ordinarily, the thickness of the spacers 44 is selected so as to match the thickness of the flat-plate-form protruding elements 22 disposed between the respective circular ring members 14a and 14b and to be at substantially the same thickness. In cases where the friction that is generated between the flat-plate-form protruding elements 22 and the respective circular ring member 14a and 14b is large, then the thickness of the spacers 44 is set slightly larger than the thickness of the flat-plate-form protruding elements 22.

[0021] Spokes in, for instance, letter Y-shape are formed so as to be connected to the inner edges of the circular ring members 14a and 14b; and a rotating shaft 48 is installed in the center of these spokes 46. Both ends of the rotating shaft 48 are rotatably supported on the casing 24. At least one end of the rotating shaft 48 protrudes to the outside of the casing 24, and this end is rotationally driven by the driving device 36. The strainer 12 is thus rotated in the direction of arrow D. Various structures are conceivable as the connecting structures between the Y-shaped spokes 46 and the strainer 12. In one example, two sets of Y-shaped spokes 46 are used, and these Y-shaped spokes 46 are connected to two circular ring members 14 positioned at both ends of the strainer 12.

[0022] The second circular ring members 14b which have the outer projections 38 on their outer circumferential surfaces are arranged so that the outer projections 38 form the ribs 50 on the outer circumferential surface of the strainer 12. Thus, the ribs 50 extend in the axial direction of the strainer 12. In other words, when the strainer 12 is viewed from one end thereof, the outer projections 38 of one second circular member 14b is positioned directly behind the outer projections 38 of the next second circular ring member 14b so that the ribs 50 are formed by these outer projections 38. As a result, a plurality of ribs 50 that extend parallel to the axis of the strainer 12 are formed on the outer circumferential

surface of the strainer 12. Since the first circular ring members 14a that have no outer projections 38 are interposed between the second circular ring members 14b, spaces are formed in the ribs 50.

[0023] The ribs 50 push and transfer the separated solid matters 16 to the di-scharge opening 34 along the inner surface of the tubular accommodating section 26.

[0024] The strainer 12 is installed inside the tubular accommodating section 26 so that the axis of rotation of the strainer 12, i.e., the rotating shaft 48 that is connected to the strainer 12, is oriented in a horizontal direction. The openings at both ends of the strainer 12 are closed off by a pair of opposite inside wall surfaces of the tubular accommodating section 26 of the casing 24. Thus, the movement of the liquid between the outer region C and inner region B of the strainer 12 is accomplished mainly by the gaps between the circular ring members 14a and 14b.

[0025] In the solid-liquid separating apparatus 10 shown in Figure 8, the intake port 28 is located at a lower position than the outlet port 30. Thus, the mixture constantly accumulates in the lower portion of the tubular accommodating section 26, the lower portion of the strainer 12 is immersed in the mixture, and the upper portion of the strainer 12 is exposed above the liquid level F of the mixture.

[0026] The discharge opening 34 is opened in the upper portion of the tubular accommodating section 26 so that the discharge opening 34 is located in the outer region C of the strainer 12. The discharge opening 34 extends in the direction of the axis of rotation of the strainer 12, so that it allows the solid matter 16, that has been separated from the liquid and carried along the inner circumferential surface of the tubular accommodating section 26 by the ribs 50, to be discharged to the outside of the casing 24.

[0027] The discharge opening 34 opens into the space of the tubular accommodating section 26 above the liquid level F of the mixture. The discharge opening 34 is located on the downstream side of the top area of the strainer 12 with respect to the direction of rotation of the strainer 12 and is on the upstream side of the scraper 20 with respect to the direction of rotation of the strainer 12.

[0028] A cover member 52 is disposed on the discharge opening 34 of the casing 24 so as to close the discharge opening 34. More specifically, one end of the cover member 52 is pivotally connected to the edge of the discharge opening 34 located on the upstream side of the discharge opening 34 with respect to the direction of rotation D of the strainer 12, so that the other end of the cover member 52 that is on the downstream side with respect to the direction of rotation D of the strainer 12 is moved or swings toward and away from the discharge opening 34 as indicated by two-head arrow in Figure 8.

[0029] The cover member 52 is constantly urged toward the strainer 12 by an urging means such as a spring, 54. The spring 54 is coupled at one end thereof to the casing 24 and at another end thereof to the cover member 53.

[0030] By way of bias of the spring 54, the cover member 52 presses the solid matter 16 that is pushed and moved by the ribs 50 of the strainer 12 against the outer circumferential surface of the strainer 12 and squeezes the liquid out of the solid matter 16.

[0031] As seen from Figure 10, the scraper 20 is constructed by stacking a plurality of flat plates sideways. The scraper 20 is, as shown in Figure 8, disposed on the downstream side of the top area of the strainer 12 with respect to the direction of rotation D of the strainer 12. In addition, the scraper 20 is disposed near the discharge opening 34 so that it is located on the downstream side of the discharge opening 34 with respect to the direction of rotation D of the strainer 12.

[0032] The scraper 20 will be further described below in regards to its more concrete structure.

[0033] The scraper 20 is comprised of plate-form first protruding elements 56, plate-form second protruding elements 58 and supporting elements 60.

[0034] Each of the first protruding elements 56 is formed from a plate material that has the same thickness as that of the respective first circular ring members 14a that make up the strainer 12, and the tip end (upper end in Figure 10) of the first protruding element 56 protrudes toward the outer circumferential surface of each one of the first circular ring members 14a so as to scrape away solid matter 16 adhering to the outer circumferential surfaces of the first circular ring members 14a.

[0035] Each of the second protruding elements 58 is formed from a plate material that has the same thickness as each one of the gaps between the first circular ring members 14a and second circular ring members 14b. The tip end (upper end in Figure 10) of the second protruding element 58 advances into the gaps between the first and second circular ring members 14a and 14b so as to scrape away solid matter 16 adhering to the respective flat end surfaces of the circular ring members 14a and 14b.

[0036] Each of the supporting elements 60 is formed from a plate material that has the same thickness as that of the respective second circular ring members 14b are formed with outer projections 38 on their outer circumferential surfaces.

[0037] The first protruding elements 56, second protruding elements 58 and supporting elements 60 are, as seen from Figure 9, disposed in a specified order in accordance with the disposing order of the first circular ring members 14a and second circular ring members 14b that make up the strainer 12. More specifically, the first protruding elements 56 are positioned so as to face the circumferential surfaces of the first circular ring members 14a, the second protruding elements 58 are positioned so that pointed end areas thereof enter into the gaps between the circular ring members 14a and 14b, and the supporting elements 60 are positioned so as to

face the circumferential surfaces of the second circular ring members 14b. The first protruding elements 56, second protruding elements 58 and supporting elements 60 are further formed into an integral unit by second stays 64 that pass through through-holes 62 formed in these elements.

[0038] In this structure, the gaps between the respective circular ring members 14a and 14b are set to be smaller than the thickness of the respective circular ring members 14a and 14b. As a result, the thickness of the second protruding elements 58 that advance into the gaps between the respective circular ring members 14a and 14b is smaller than the thickness of the circular ring members 14a and 14b. Thus, the strength of the second protruding elements 58 might be insufficient. Accordingly, the second protruding elements 58 are reinforced by being interposed between the first protruding elements 56 and the supporting elements 60 that are positioned on both sides of the second protruding elements 58.

[0039] In the structures shown in Figures 9 and 10, the first circular ring members 14a are positioned at both ends of the strainer 12 (which is a cylindrical shape as a whole). Accordingly, the first protruding element 56, the second protruding element 58 and the supporting element 60 are disposed in this order from one end of the scraper 20, thus forming a "unit"; and this "unit" is repeated in the direction of the second stays 64, and the first protruding element 56 is disposed at another end of the scraper 20.

[0040] Here, the first protruding elements 56, supporting elements 60 and second stays 64 also function as a supporting member 32 which holds and supports the second protruding elements 58 that enter the spaces between the first circular ring members 14a and second circular ring members 14b and scrape away the solid matter 16.

[0041] In the structure shown in Figure 10, the first protruding elements 56 which are positioned at both ends of the scraper 20 differ in shape from other first protruding elements 56 positioned in the intermediate portions of the scraper 20. In other words, the first protruding elements 56 at both ends are larger and have a broader area compared to other first protruding elements 56. The intention is to have these first protruding elements 56 at both ends hold the cover member 52 (positioned on the upstream side of the scraper 20 with respect to the direction of rotation D of the strainer 12) from both sides so that both ends of the cover member 52 are covered by these first protruding elements 56.

[0042] The solid material 16 moved by the strainer 12 are scraped away while being traveling downward from the top area of the strainer 12, thus being separate from the strainer 12 and discharged out through the discharge opening 34.

[0043] However, the above-described solid-liquid separating apparatus has problems.

[0044] What determines the solid-liquid separating performance of the strainer 12 is, as described above, the dimension (width) of the gaps between (the end surfaces of) the respective circular ring members 14 that are disposed next to each other; and this dimension is determined by the thickness of the flat-plate-form protruding elements 22 which are inserted into only limited portions of the ring-shape gaps between the respective circular ring members 14.

[0045] Therefore, in order to improve the solid-liquid separating performance of the strainer 12, it is necessary to narrow these gaps. However, if it is desired to ensure the durability and mechanical strength of the flat-plate-form protruding elements 22, there are limits to how far the thickness of the flat-plate-form protruding elements 22 can be reduced.

[0046] In other words, in the prior art apparatus, the solid-liquid separating performance of the strainer 12 is limited by the thickness of the flat-plate-form protruding elements 22 of the scraper 20.

SUMMARY OF THE INVENTION

[0047] Accordingly, the present invention solves the above-described problems.

[0048] The object of the present invention is to provide a solid-liquid separating apparatus that provides an improved solid-liquid separating performance of the strainer without being affected by the structure of the scraper.

[0049] The above object is accomplished by a unique structure for a solid-liquid separating apparatus that is comprised of:

a strainer that is a cylindrical body formed by a plurality of flat-plate-form circular ring members with gaps in between;

a casing with an accommodating section for accommodating therein the strainer, the accommodating section being divided by the strainer into an internal region that is inside the strainer and an external region that is outside the strainer, an intake port that introduces a mixture of solid matter and liquid being formed in the external region, and an outlet port that discharges to the outside the liquid that passes between the circular ring members and advances into the internal region being formed in the internal region, and

a plurality of scrapers that are provided in the gaps between the circular ring members, the scrapers being moved along the outer circumferential surfaces of the circular ring members so as to scrape away the solid matter adhering to the circular ring members,

wherein the unique structure of the present invention is that the each of the scrapers is comprised of:

a flat-plate-form auxiliary circular ring member having an external diameter that is smaller than the external diameter of the circular ring members and is

larger than the internal diameter of the circular ring members, and
a flat-plate-form protruding element extending from the outer circumferential surface of the auxiliary circular ring member, the protruding element being in the same plane as the auxiliary circular ring member, and wherein
the auxiliary circular ring member is disposed in coaxial with the circular ring members, and the flat-plate-form protruding element has a length that reaches the outer circumferential surfaces of the circular ring members.

[0050] With the above structure, the solid-liquid separating performance of the strainer is determined by the dimension of the gaps between the end (flat) surfaces of the circular ring members that form the strainer and the end (flat) surfaces of the auxiliary circular ring members of the scraper that are disposed between the circular ring members in coaxial with the circular ring members. In other words, the solid-liquid separating performance of the strainer is not affected by the thickness of the auxiliary circular ring members. As a result, the present invention provides an improved solid-liquid separating performance while the thickness of the auxiliary circular ring members is kept at dimensions that ensure the strength and durability of the auxiliary circular ring members.

[0051] Furthermore, in the present invention, a plurality of the flat-plate-form protruding elements are installed by being lined up in a single row. With this arrangement, the end surfaces of the flat-plate-form protruding elements located on the upstream side with respect to the direction of rotation of the strainer collectively form a single scraping surface. Thus, solid matter is efficiently scraped away by the scraper and easily discharged to the outside of the casing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0052]

Figure 1 is an explanatory diagram that illustrates the basic concept of the solid-liquid separating apparatus according to the present invention;
Figure 2 is a front view of a scraper of the present invention comprising the auxiliary circular ring member and the flat-plate-form protruding element;
Figure 3 is a sectional front view of the solid-liquid separating apparatus according to the present invention;
Figure 4 is a front view of another scraper of the present invention comprising the auxiliary circular ring member and the flat-plate-form protruding element;
Figure 5 is an enlarged sectional view of the essential portion of the strainer taken along the axis line thereof, illustrating the positional relationship between the circular ring members that form the strainer and the auxiliary circular ring members that form the scraper;
Figure 6 is an explanatory diagram of the basic concept of a prior art solid-liquid separating apparatus;
Figure 7 is a sectional view taken along the axis of rotation of the strainer in the apparatus of Figure 6;
Figure 8 is a sectional front view of the structure of the prior art solid-liquid separating apparatus;
Figure 9 is a side view of the strainer of the separating apparatus of Figure 8; and
Figure 10 is an exploded disassembled view of the strainer shown in Figure 8.

DETAILED DESCRIPTION OF THE INVENTION

[0053] Preferred embodiments of the solid-liquid separating apparatus of the present invention will be described below in detail with reference to the accompanying drawings.

[0054] The constituting elements of the solid-liquid separating apparatus 70 of the present invention shown in Figures 1 and 2 are substantially the same as those of the solid-liquid separating apparatus 10 shown in Figures 6 and 7. Accordingly, the elements that are the same as those of Figures 6 and 7 are labeled with the same reference numerals, and a description of such elements is omitted. Only the constituting elements that differ from the shown prior art and make the characterizing features of the present invention will be described below.

[0055] As seen from Figure 1, the solid-liquid separating apparatus 70 of the present invention substantially comprises the strainer 12, the casing 24, a scraper 72 and the driving device (not shown but is the same as the driving device 36 shown in Figure 7).

[0056] The feature of the solid-liquid separating apparatus 70 of the present invention is the scraper 72. In the present invention, the scraper 72 comprises a flat-plate-form circular ring member (auxiliary circular ring member) 74 that is integrally connected to the tip end of the flat-plate-form protruding element 22. In other words, the scraper 72 takes a structure in which the flat-plate-form protruding element 22 is extended from the outer circumferential surface of the auxiliary circular ring member 74; and the auxiliary circular ring member 74 has the same thickness as the flat-plate-form protruding element 22, so that the protruding element 22 is in the same plane as the auxiliary circular ring member 74. For convenience of description, the auxiliary circular ring member 74 and flat-plate-form protruding element 22 will hereafter be collectively referred to as a "scraper component(s) 76".

[0057] The structure of the scraper component 76 will be described in detail with reference to Figures 1 and 2.

[0058] First, the auxiliary circular ring member 74 is formed so that the external diameter is smaller than the external diameter of the circular ring members 14 that

form the strainer 12. Also, the external diameter of the auxiliary circular ring member 74 is larger than the internal diameter of the circular ring members 14. In the shown embodiment, the internal diameter of the auxiliary circular ring members 74 is smaller than the internal diameter of the circular ring members 14 (see Figure 5). However, the present invention is not limited to this arrangement. The internal diameter of the auxiliary circular ring member 74 can be the same as the internal diameter of the circular ring members 14 or greater than the internal diameter of the circular ring members 14.

[0059] The flat-plate-form protruding element 22 of scraper component 76 is formed so as to extend from the outer circumferential surface of the flat-plate-form auxiliary circular ring member 74 as an integral part of the auxiliary circular ring member 74. The flat-plate-form protruding element 22 is on the same plane as the flat surface of the auxiliary circular ring members 74.

[0060] A plurality of scraper components 76 are respectively provided between gaps between adjacent circular ring members 14. In other words, one scraper component 76 is disposed in intermediate position in each of the gaps between the circular ring members 14 which are arranged side by side, the gaps being slightly greater than the thickness of the scraper component 76. The auxiliary circular ring members 74 (of the scraper components 76) are installed so as to be coaxial with the circular ring members 14. The outer ends of the flat-plate-form protruding elements 22 reach the outer circumferential surfaces (or protrude over the outer circumferential surfaces) of the circular ring members 14.

[0061] As a result of this arrangement, when the strainer 12 with the scraper components 76 assembled therein is viewed from one end, as seen from Figure 1, some or all of the auxiliary circular ring members 74 of the scraper components 76 overlap in the entire inner circumferential area of the circular ring members 14 for an annular region that has a width G (see Figure 3 and 5).

[0062] Accordingly, when the liquid 18 passes from the external region C into the internal region B in the strainer 12, this liquid inevitably passes through the annular region that has the width G. Furthermore, in this annular region, the liquid 18 passes through the gaps that are formed between the end (flat) surfaces of the auxiliary circular ring members 74 and the end (flat) surfaces of the circular ring members 14 that face each other. In the present invention, these gaps can be freely set without taking the thickness of the scraper components 76 or the thickness of the auxiliary circular ring members 74 into consideration and can therefore naturally be set smaller than the thickness of the auxiliary circular ring members 74. The solid-liquid separating performance of the solid-liquid separating apparatus 70 of the present invention is thus significantly better than that of the prior art solid-liquid separating apparatus 10 in which the solid-liquid separating performance is limited by the thickness of the flat-plate-form protruding elements 22.

[0063] Furthermore, the flow path for the liquid 18 that contains solid matter 16 and has once entered the gaps between the circular ring members 14 is constricted by the auxiliary circular ring members 74 that are disposed on the inner circumferential side of the circular ring members 14; as a result, the force of the liquid is weakened. Accordingly, the liquid 18 resides in the gaps between the circular ring members 14 for a longer time, and the amount of solid matter 16 that adheres to the end (flat) surfaces of the circular ring members 14 increases. The solid-liquid separating performance is thus enhanced.

[0064] Next, the structure of the solid-liquid separating apparatus 70 will be described in a more concrete fashion with reference to Figures 3 through 5. The basic structure is the same as that of the prior art solid-liquid separating apparatus 10 shown in Figures 8 through 10. Accordingly, the same constituting elements will be labeled with the same reference numerals, and a description of such elements will be omitted.

[0065] The characterizing features of the solid-liquid separating apparatus 70 of the present invention lie in the scraper 72 as described above. In the present invention, instead of the prior art second protruding elements 58 shown in Figure 10, a scraper component 76 as shown in Figure 4 is provided between the first and second circular ring members 14a and 14b so that the auxiliary circular ring member 74 is coaxial with the circular ring members 14a and 14b.

[0066] More specifically, the flat-plate-form protruding element 22 of the scraper component 76 is substituted for the prior art second protruding element 58 and is disposed in a position of the second protruding element 58 shown in Figure 10. The flat-plate-form protruding element 22 has the length so as to traverse the external region C of the casing 24; and as best seen the tip end of this flat-plate-form protruding element 22 is fixed to the casing 24. Second stays (that are referred to by the reference numeral 64 in Figure 10) are passed through a plurality of protruding elements 22, so that the protruding elements 22 or the scraper components 76 are held and supported by the first protruding elements 56 and supporting elements 60.

[0067] The positional relationship between the first and second circular ring members 14a and 14b and the auxiliary circular ring members 74, which are integrally connected to the flat-plate-form protruding elements 22 that enter the gaps between the first and second circular ring members 14a and 14b, is substantially the same as that in the first embodiment. In other words, as seen from Figure 5, the auxiliary circular ring members 74 are positioned on the inner circumferential side of the ring-form gaps formed between the first and second circular ring members 14a and 14b, and the area of mutual overlapping is defined as an annular region that has a width G.

[0068] Furthermore, the width W of the gaps H between the first circular ring members 14a and second

circular ring members 14b (i.e., the width along the axial direction of the strainer 12 (right and left directions in Figure 5)) is set so as to be greater than the thickness T of each of the scraper components 76; and the scraper components 76 are disposed in intermediate positions in the gaps H. As a result, gaps I are formed between the end (flat) surfaces of the auxiliary circular ring members 74 of the scraper components 76 and the end (flat) surfaces of the first and second circular ring members 14a and 14b that face the end surfaces of the auxiliary circular ring members 74; and such gaps I on both sides of each of the auxiliary circular ring member 74 have the same size of width X. Working precision or assembly precision would cause the auxiliary circular ring members 74 to shift positionally; and in such a situation, there may be some variation in the width X of the gaps I on both sides of each one of the scraper components 76.

[0069] When the liquid 18 that contains solid matter 16 flows into the internal region B of the strainer 12 from the external region C, this liquid 18 inevitably passes through the annular region that has the width G. Accordingly, the width X of the very narrow gaps I between the first and second circular ring members 14a and 14b determines the solid-liquid separating performance.

[0070] The width X of the gaps I can be independently set without being affected by the thickness T of the scraper components 76 (i.e., the thickness of the flat-plate-form protruding elements 22 and auxiliary circular ring members 74). Accordingly, unlike the prior art in which the width W of the gaps H between the first and second circular ring members 14a and 14b cannot be set smaller than the thickness of the flat-plate-form protruding elements 22, the solid-liquid separating performance (filtration performance) in the present invention is greatly improved while maintaining the thickness T of the scraper components 76 at a dimension that ensures the strength and durability.

[0071] The above embodiments are described with reference to a solid-liquid separating apparatus that is used in a raw contaminant dehydration treatment device and separates pulverized raw contaminants and water. It goes without saying that the present invention can be used for other than the separation of raw contaminants and water.

[0072] As seen from the above, in the solid-liquid separating apparatus of the present invention, gaps that determine the solid-liquid separating performance are obtained by the spaces between the auxiliary circular ring members of the scraper and the circular ring members of the strainer. Accordingly, unlike the prior art structure, the width of these gaps can be set smaller than the thickness of the scraper. In the prior art structure, however, the width of the gaps between the circular ring members of the strainer that determine the solid-liquid separating performance is affected by the thickness of the flat-plate-form protruding elements of the scraper and the width of such gaps cannot be set smaller than the thickness of the flat-plate-form protruding elements. Furthermore, in the present invention, the gaps that are present between the circular ring members and determine the solid-liquid separating performance can be set at the minimum without being affected by the thickness of the scraper. Accordingly, the present invention provides a greatly improved solid-liquid separating performance while the scraper has a thickness of sufficient strength and durability.

Claims

1. A solid-liquid separating apparatus comprising:

a strainer that is a cylindrical body formed by a plurality of flat-plate-form circular ring members with gaps in between;
a casing with an accommodating section for accommodating therein said strainer, said accommodating section being divided by said strainer into an internal region that is inside said strainer and an external region that is outside said strainer, an intake port that introduces a mixture of solid matter and liquid being formed in said external region, and an outlet port that discharges, to an outside of said casing, liquid that passes between said circular ring members and advances into said internal region being formed in said internal region, and
a plurality of scrapers that are provided in said gaps between said circular ring members, said scrapers being moved in relative terms along outer circumferential surfaces of said circular ring members so as to scrape away solid matter adhering to said circular ring members,

wherein each of said scrapers is comprised of:

a flat-plate-form auxiliary circular ring member having an external diameter that is smaller than external diameter of said circular ring members and is larger than internal diameter of said circular ring members, and
a flat-plate-form protruding element extending from an outer circumferential surface of said auxiliary circular ring member, said protruding element being in a same plane as said auxiliary circular ring member, and wherein
said auxiliary circular ring member is disposed in coaxial with said circular ring members, and said flat-plate-form protruding element has a length that reaches said outer circumferential surfaces of said circular ring members.

2. The solid-liquid separating apparatus according to Claim 1, wherein said flat-plate-form protruding element is disposed in plural numbers so as to be

lined up in a single row.

3. A solid-liquid separating apparatus comprising:

a strainer that is a cylindrical body formed by a plurality of flat-plate-form circular ring members with gaps in between;
a casing with an accommodating section for accommodating therein said strainer so that said strainer is rotated, said accommodating section being divided by said strainer into an internal region that is inside said strainer and an external region that is outside said strainer, an intake port that introduces a mixture of solid matter and liquid being formed in said external region, and an outlet port that discharges, to an outside of said casing, liquid that passes between said circular ring members and advances into said internal region being formed in said internal region, and
a plurality of scrapers provided in said gaps between said circular ring members that form said strainer, said scrapers coming into contact with solid matter adhering to said circular ring members when said strainer is rotated, thus scraping away said solid matter adhering to said circular ring members,

wherein each of said scrapers is comprised of:

a flat-plate-form auxiliary circular ring member having an external diameter that is smaller than external diameter of said circular ring members and is larger than internal diameter of said circular ring members, and
a flat-plate-form protruding element extending from an outer circumferential surface of said auxiliary circular ring member, said protruding element being in a same plane as said auxiliary circular ring member, and wherein
said auxiliary circular ring member is disposed in coaxial with said circular ring members, and said flat-plate-form protruding element traverses said external region of said casing with a tip end thereof fixed to said casing.

FIG. 1

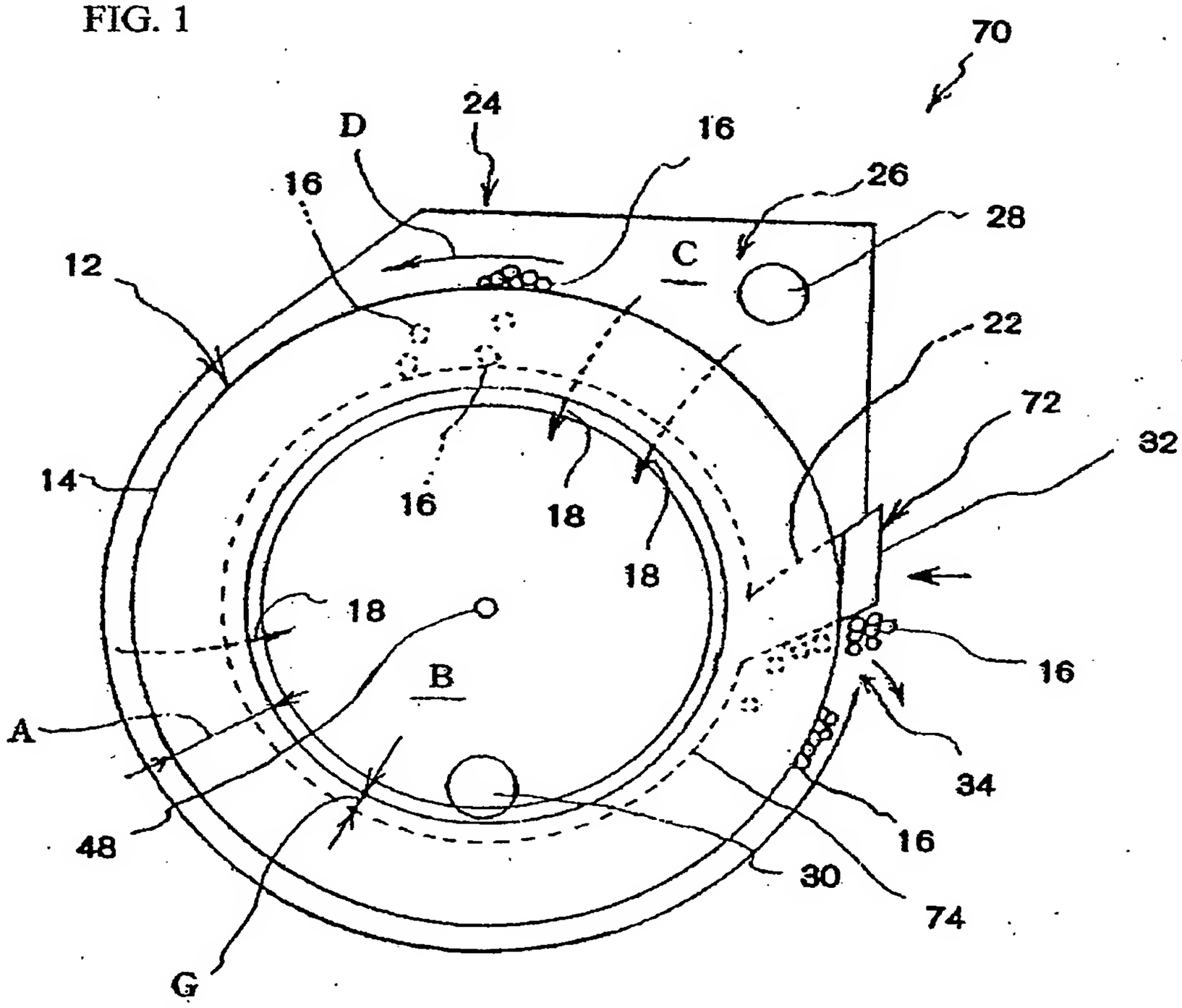


FIG. 2

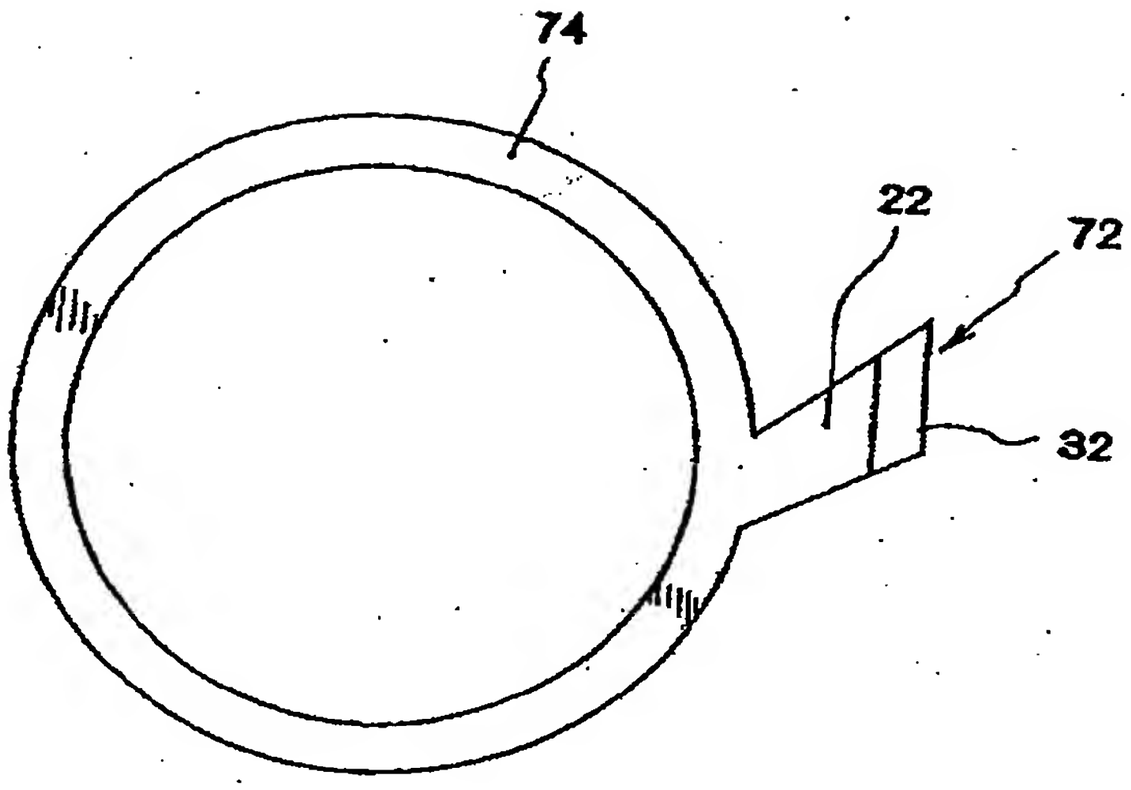


FIG. 3

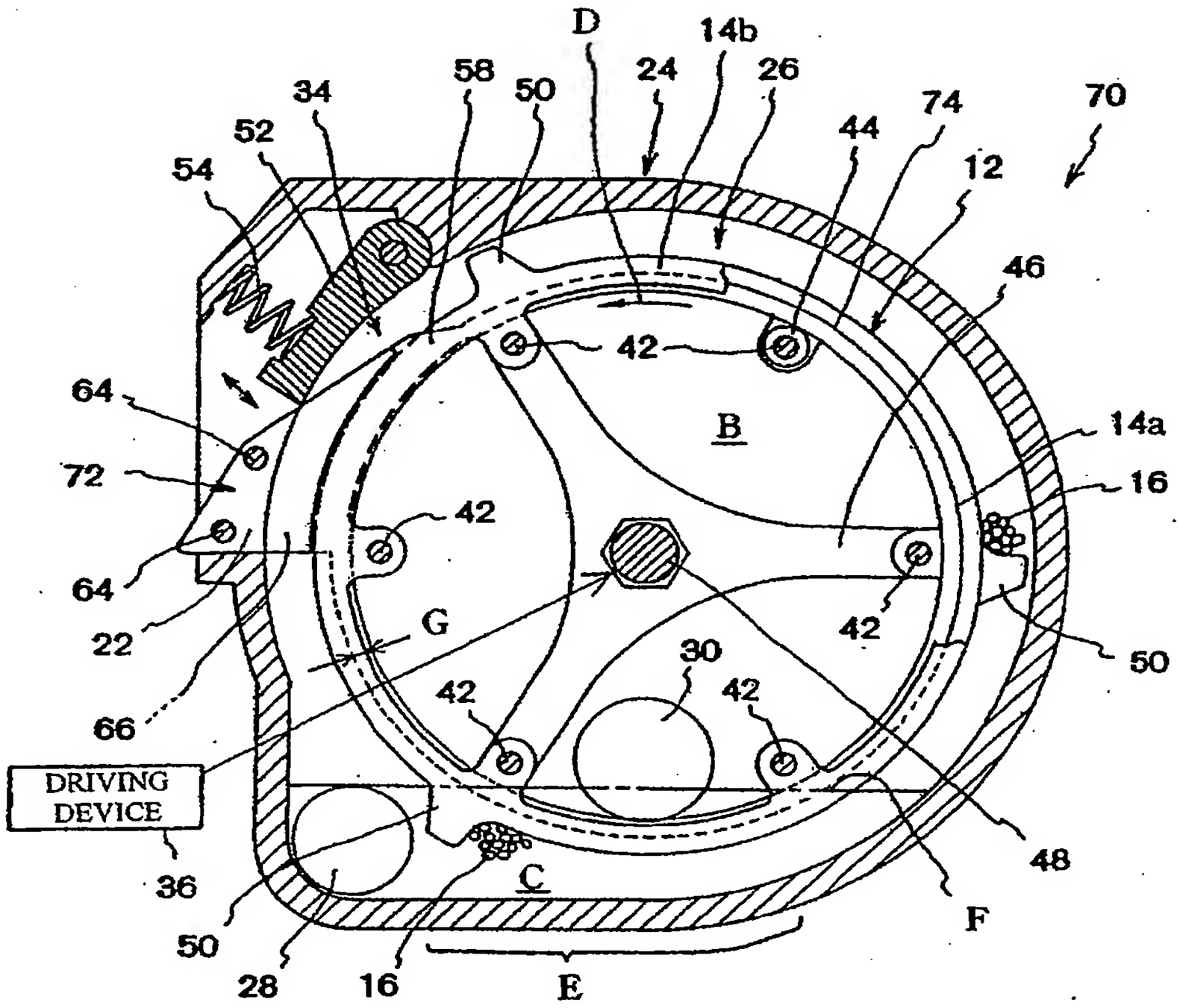

D
14b
58
24
26
34
50
74
70
52
44
12
54
46
42
64
B
14a
72
16
42
64
42
22
G
30
42
42
50
66
DRIVING DEVICE
48
36
C
50
F
28
16
E

FIG. 4

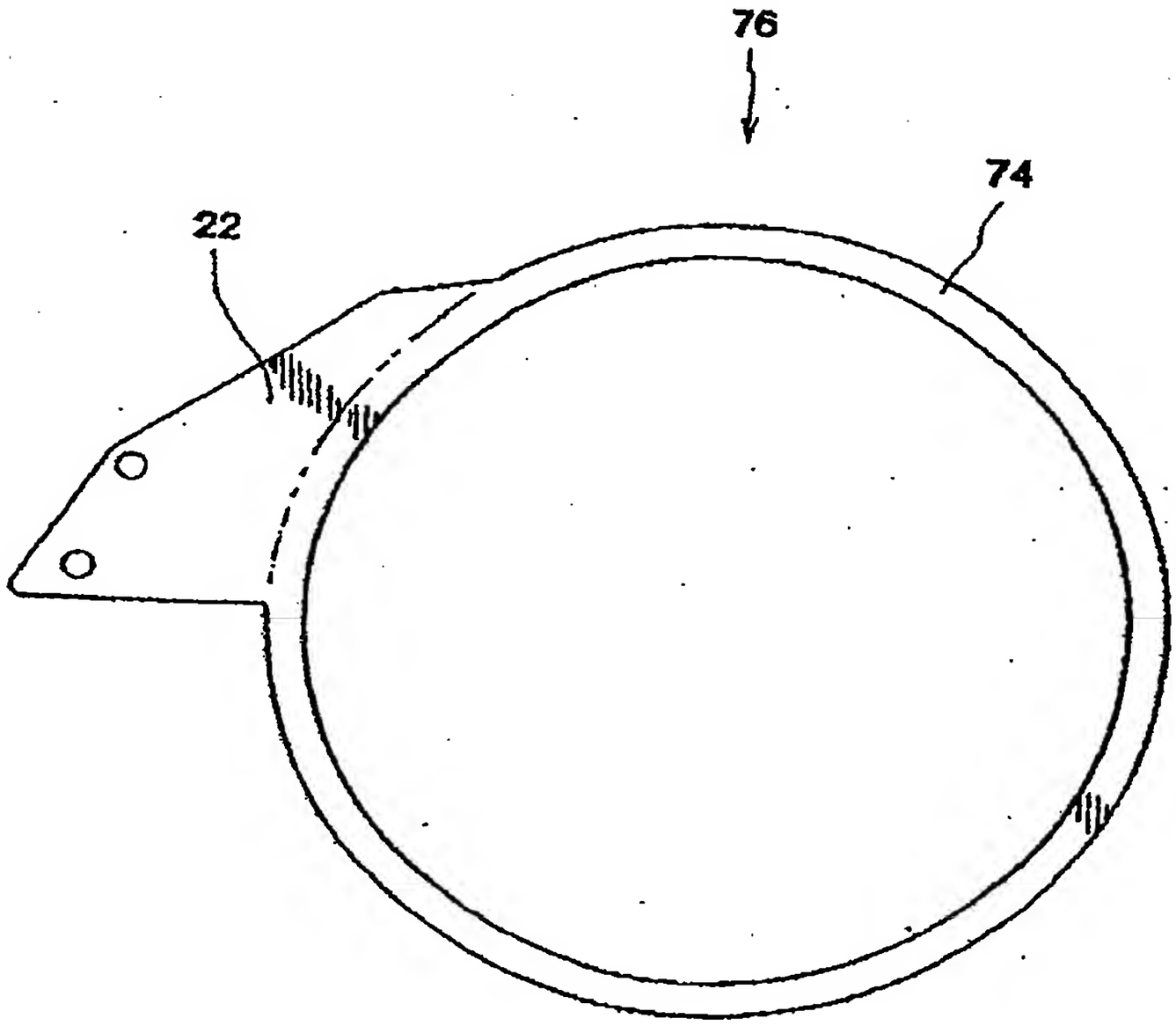


FIG. 5

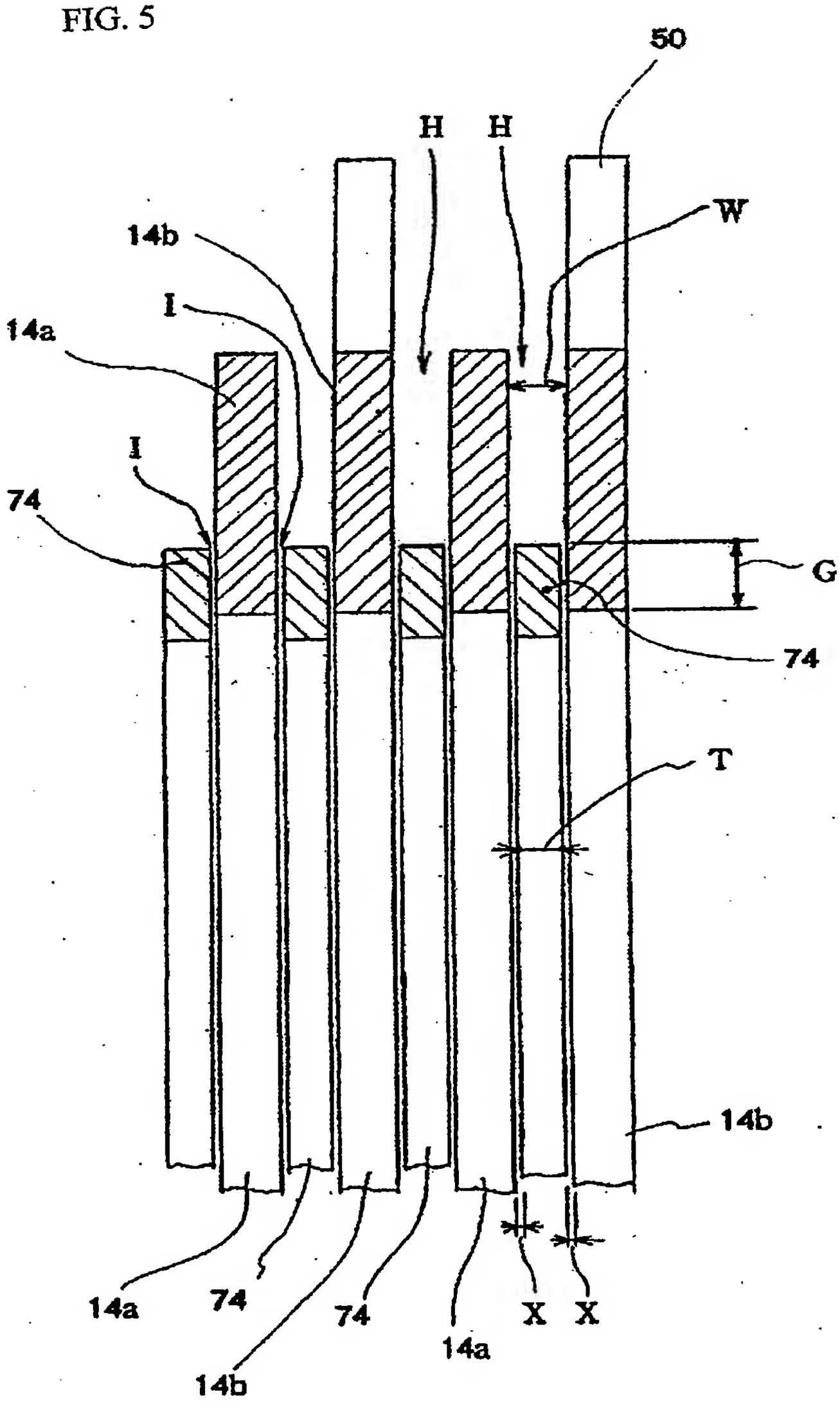


FIG. 6
PRIOR ART

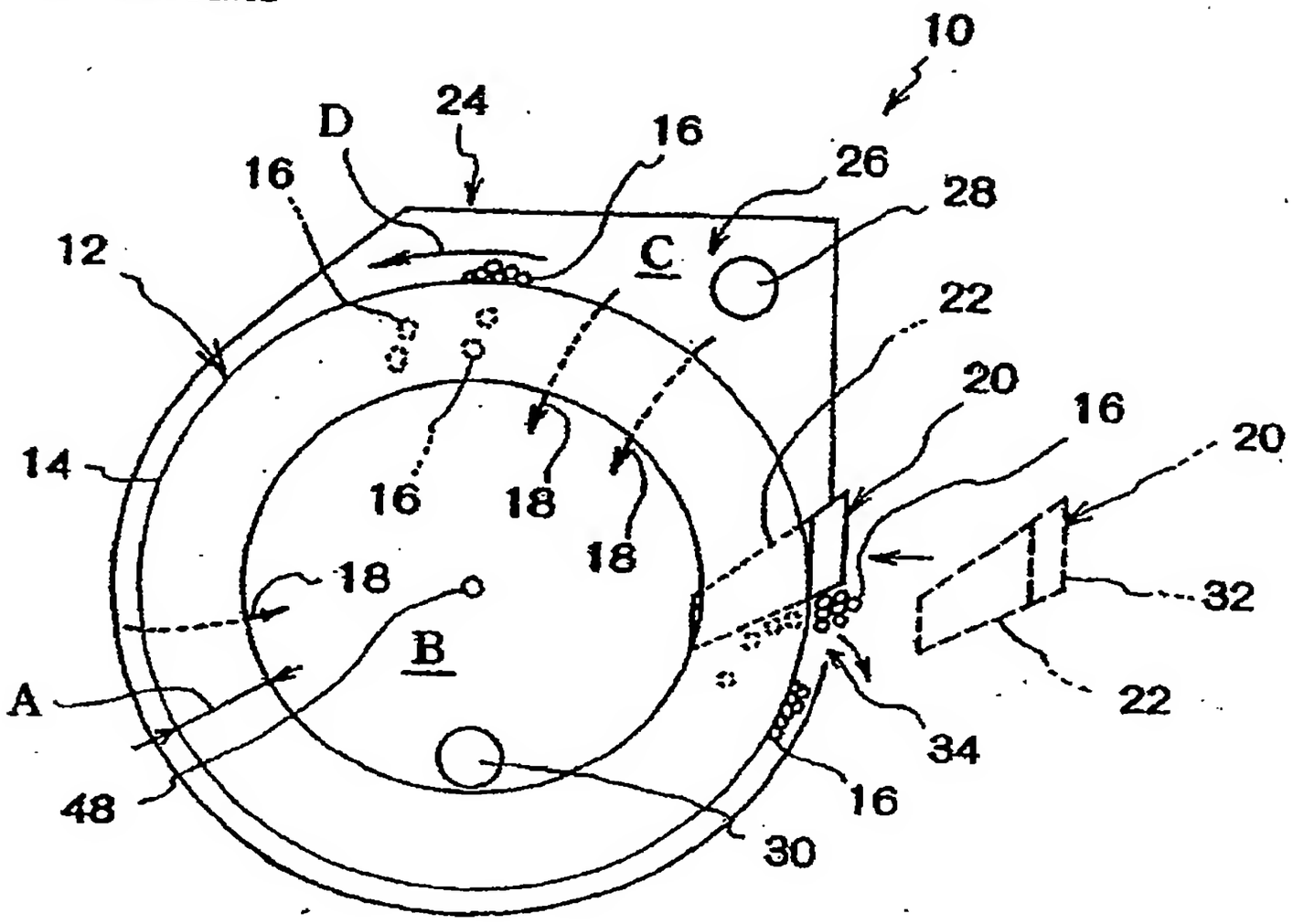


FIG. 7
PRIOR ART

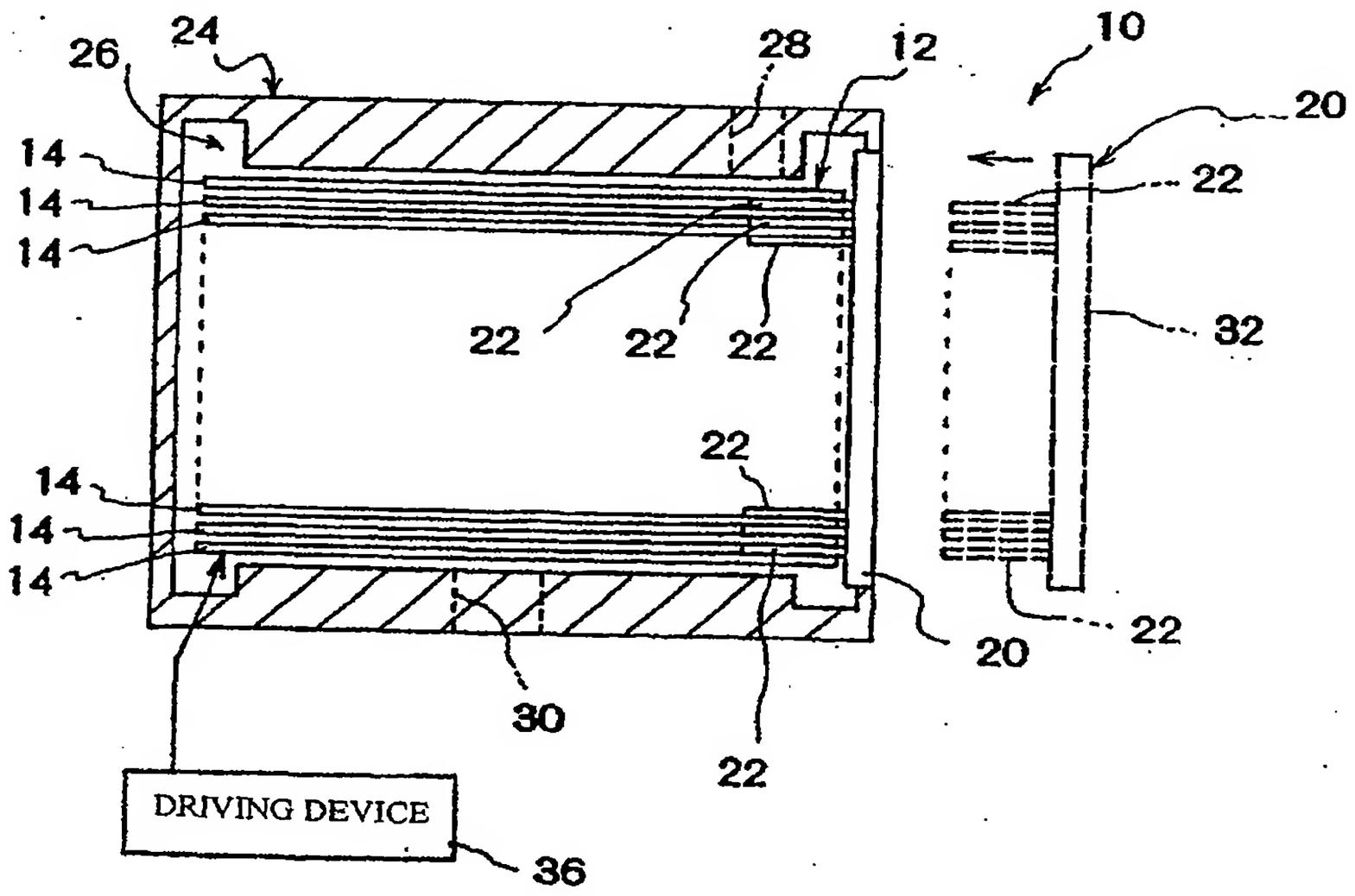


FIG. 8
PRIOR ART

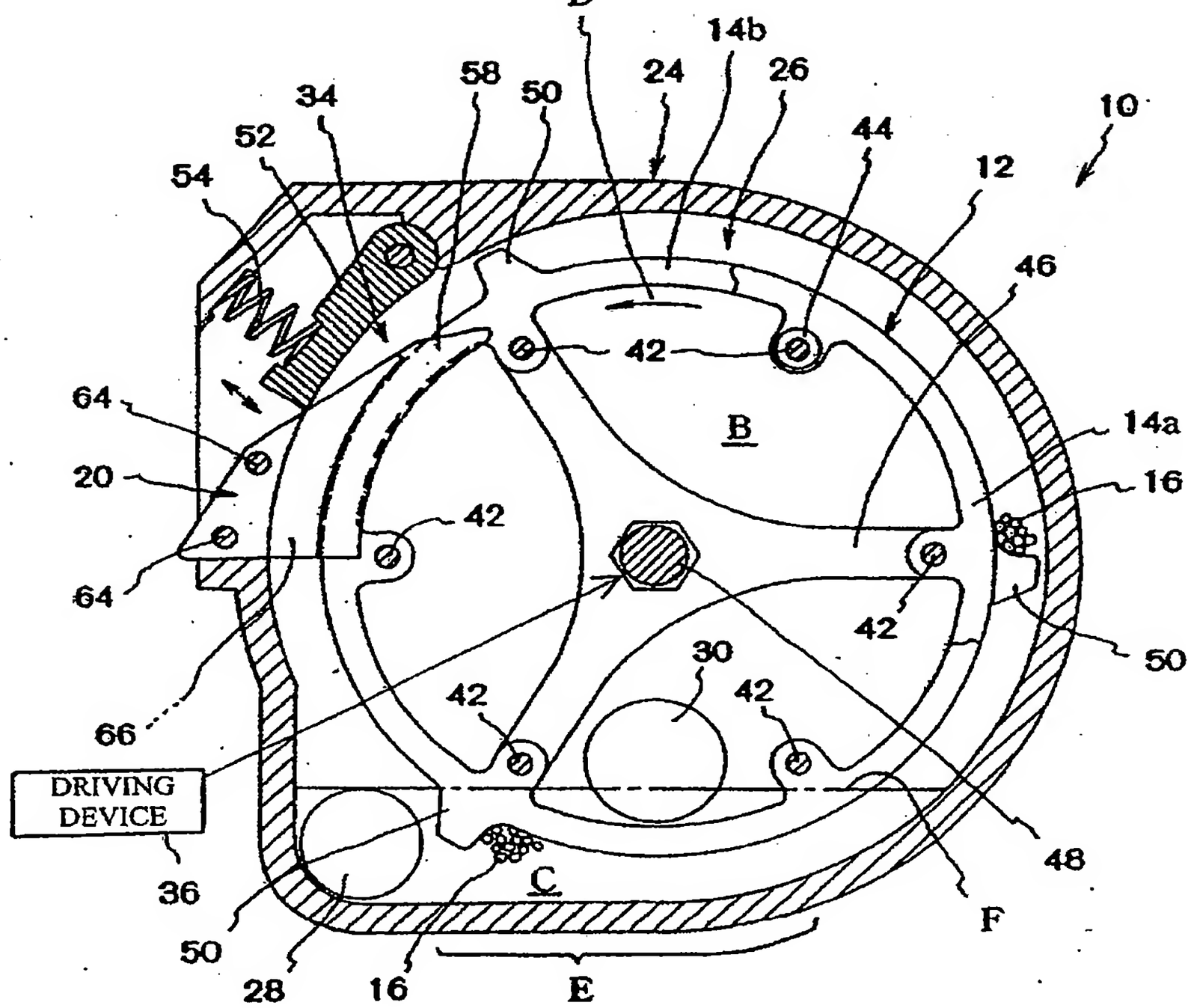


FIG. 9
PRIOR ART

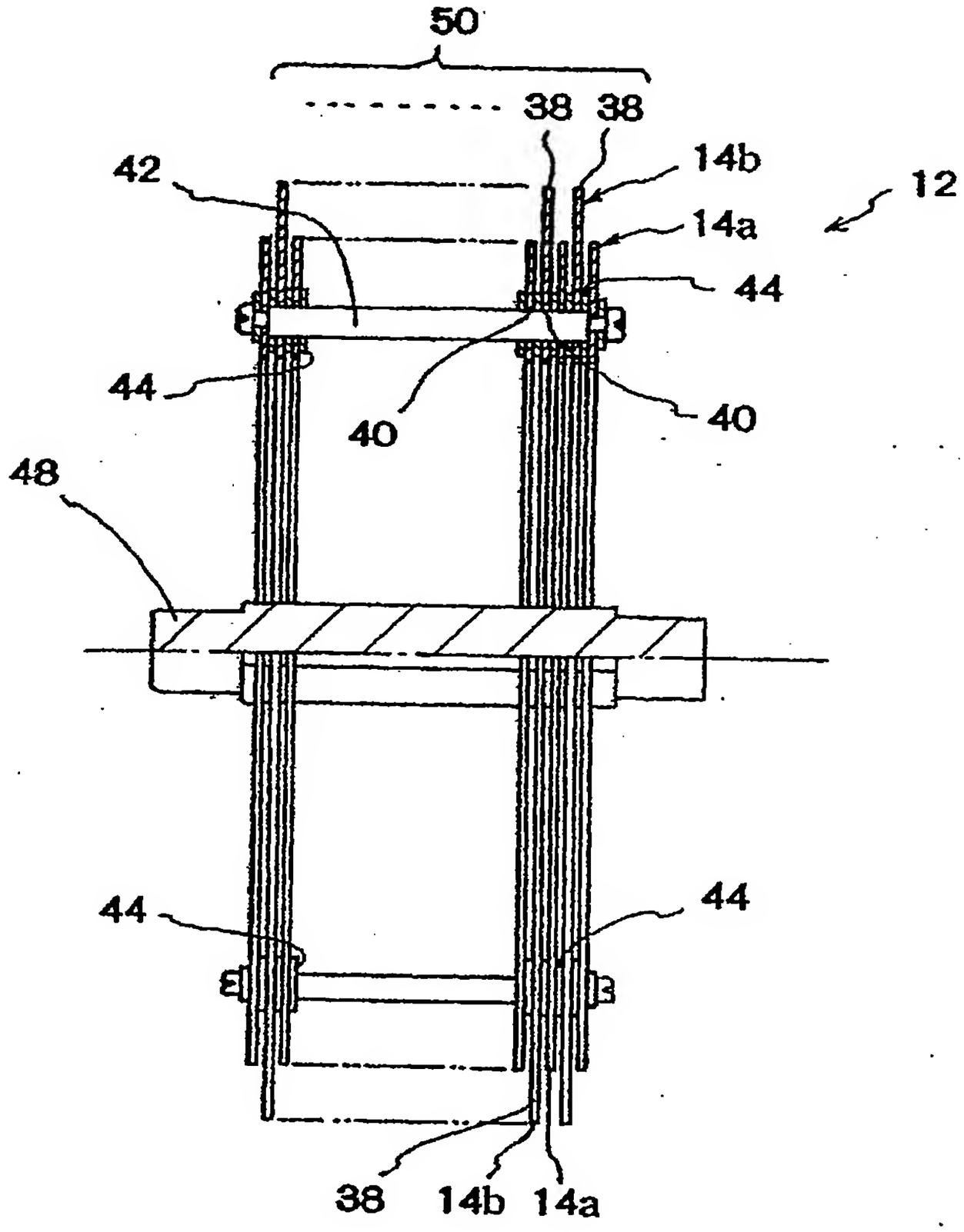
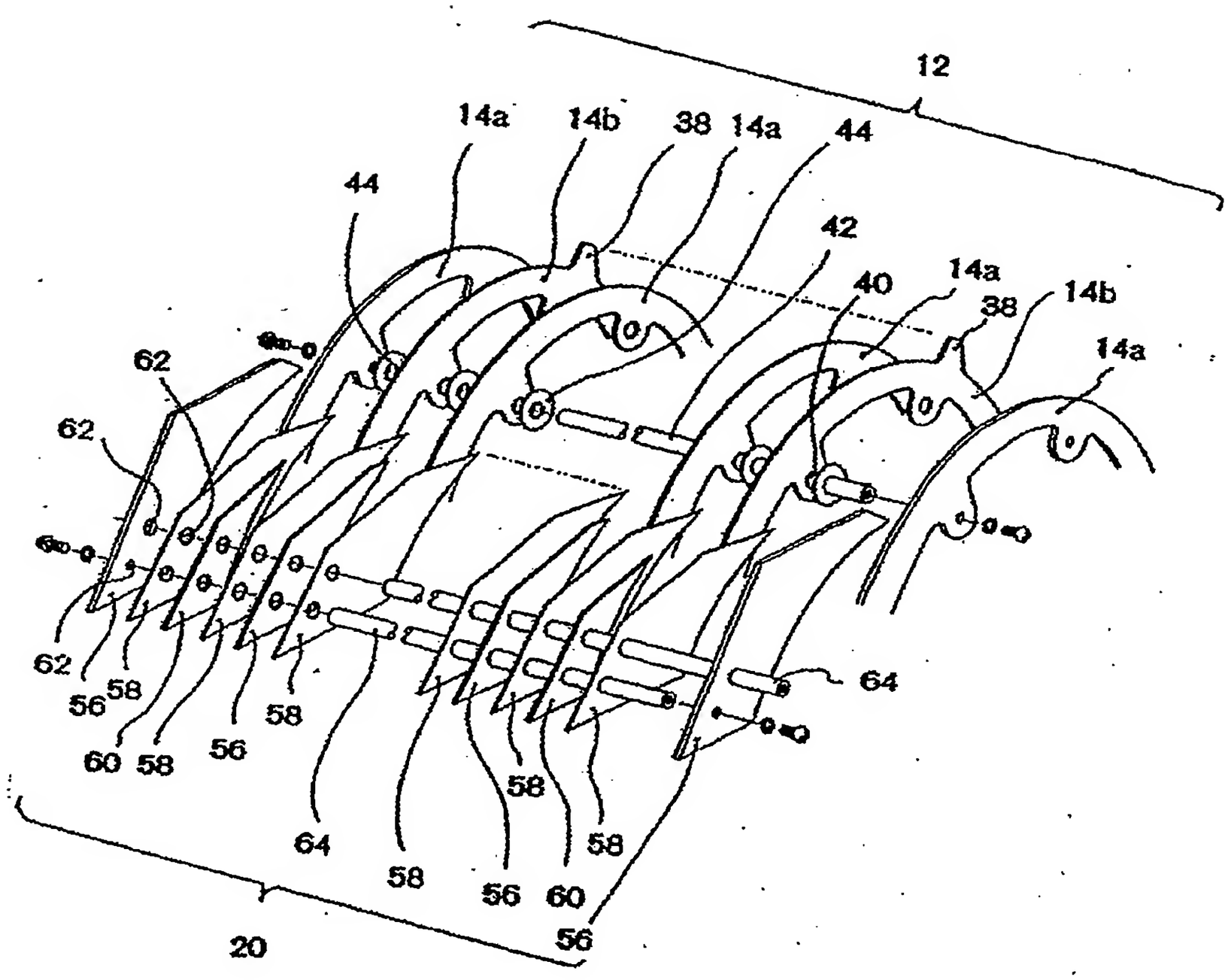


FIG. 10
PRIOR ART



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 11 3811

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A,D	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 14, 5 March 2001 (2001-03-05) & JP 2000 317693 A (IZUMI PRODUCTS CO), 21 November 2000 (2000-11-21) * abstract *	1-3	B01D33/073 B01D33/27 B01D33/46 B01D33/64
A	US 4 279 750 A (HORI MITUTAKA) 21 July 1981 (1981-07-21) * the whole document *	1-3	
A	US 3 616 914 A (REID JAMES S) 2 November 1971 (1971-11-02) * column 3, line 6 - line 19 * * figures 3,4 *	1-3	
A	GB 1 200 208 A (KOEHLER-DAYTON) 29 July 1970 (1970-07-29) * page 1, line 37 - line 80 * * page 2, line 5 - line 32 * * page 4, line 40 - line 58 * * claims; figures 4,5 *	1-3	
A	US 4 147 633 A (KATO YOSHIHARU) 3 April 1979 (1979-04-03) * the whole document *	1-3	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7) B01D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12 September 2001	Hilt, D

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 01 11 3811

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

12-09-2001

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2000317693 A	21-11-2000	CN 1273871 A	22-11-2000
US 4279750 A	21-07-1981	JP 55116413 A	08-09-1980
US 3616914 A	02-11-1971	NONE	
GB 1200208 A	29-07-1970	FR 1545993 A	
US 4147633 A	03-04-1979	NONE	

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 119602	**FOR FURTHER ACTION**	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. **PCT/AU2004/001230**	International filing date *(day/month/year)* 10 September 2004	(Earliest) Priority Date *(day/month/year)* 3 October 2003
Applicant WEATHERFORD AUSTRALIA PTY LIMITED et al		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language,** the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

      ☐ The international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (See Box No. II).

3. ☐ **Unity of invention is lacking** (See Box No. III).

4. With regard to the **title,**

   ☒ the text is approved as submitted by the applicant.

   ☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

   ☒ the text is approved as submitted by the applicant.

   ☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings,**

   a. the figure of the **drawings** to be published with the abstract is Figure No. **2**

      ☐ as suggested by the applicant.

      ☐ as selected by this Authority, because the applicant failed to suggest a figure.

      ☒ as selected by this Authority, because this figure better characterizes the invention.

   b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2004/001230

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: B01D 35/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC[7] as above

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Derwent WPI: IPC[7] as above and screen or nozzle

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6332545 B1 (Izumi) 25 December 2001 Whole Document	
A	US 6579458 B2 (Mickelat et al) 17 June 2003 Whole Document	
A	CA 2391853 A1 (Dependable Truck and Tank Ltd.) 9 July 2003 Whole Document	
A	EP 1161977 A1 (Izumi Products Co.) 12 December 2001 Whole Document	

☐ Further documents are listed in the continuation of Box C

☒ See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 October 2004	19 OCT 2004
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	**Authorized officer** **DAVID K. BELL** Telephone No : (02) 6283 2309

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	6332545	CN	1273871	ID	25957	JP	2000317693
		SG	80678				
US	6579458	CA	2344477	DE	19842042	EP	1114218
		US	2001032816	WO	0015901		
CA	2391853	US	2004007518				
EP	1161977	CN	1328861	ID	30461	JP	2001347399
		SG	89398	US	2002000406		

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX